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EDITED BY CHAS. COOPER AND J. FOSTER PETREE.

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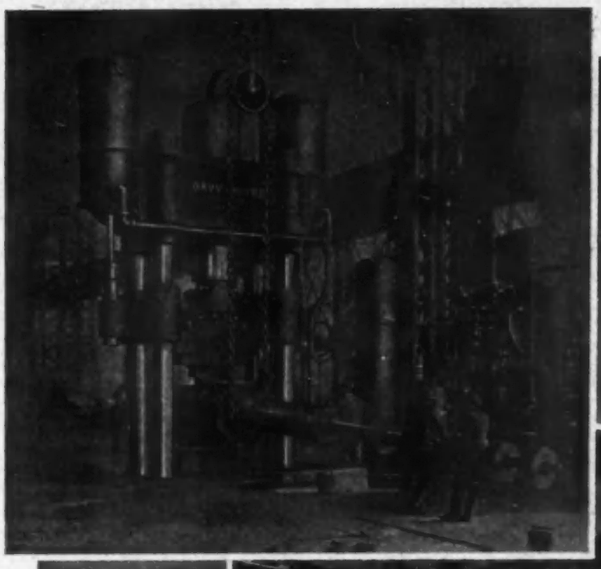

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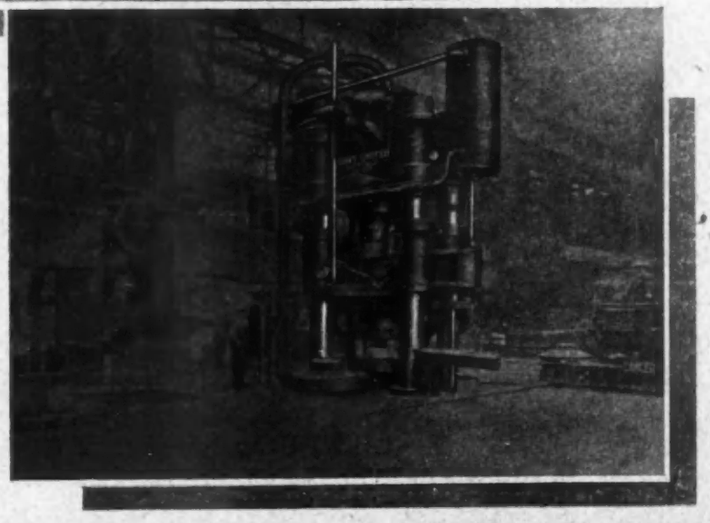

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DAM CONSTRUCTION IN THE TENNESSEE VALLEY.

(*Concluded from page* 162.)

THE construction of the Pickwick Landing Dam was carried out in three stages, of which the building of the lock and embankments, described in the previous article, formed the first. The second stage covered the construction of the power house substructure and about 400 ft. of the north end of the spillway, which was completed in the third stage. The procedure followed is illustrated in Figs. 56 to 63, on page 202, which show a plan of the complete works, with various cross-sections. As will be seen, three cellular sheet-pile cofferdams were employed. The first, enclosing the lock site, and covering Stage 1, has already been referred to. Its position in relation to the other works is clearly shown in Figs. 56 and 60. Part of it can also be seen in the aerial photograph reproduced in Fig. 55, on this page. This shows the completed lock chamber and the second cofferdam under construction. Some of the cells of the first cofferdam can be seen at the west end of the lock structure. The remainder have been removed to form the second cofferdam, which is in process of construction in the river. Parts of both the north and south embankments, which were described in the previous article, can also be seen in the illustration.

FIG. 55. AERIAL VIEW OF PICKWICK LANDING DAM UNDER CONSTRUCTION.

As shown in Fig. 56, and as can clearly be seen in Fig. 53, on page 170, *ante*, the sheet-piling cells were of cylindrical form, driven side by side, but not in contact. The spaces between them were closed by short connecting sheet-piling segments laid out in an arc of much shorter radius than the main cells. This was referred to in the previous article, but will, perhaps, be more clearly understood from the plan given in Fig. 56. The advantage of making the main sheet-pile cells as self-contained units was that they could be driven, and later removed, individually without interfering with neighbouring cells. It was also possible to drive all of them by using a single special template which formed each cell with great accuracy.

The template is illustrated in Fig. 64, on Plate XVI. It consisted of a cylindrical steel framework, carried by four 10-in. pipes which were driven vertically into the ground. These pipes were first placed in position, and the template then erected on them. Some latitude in the connections between the framework and the pipes was allowed, so that the template, which served as a guide to the sheet-piles, could be adjusted accurately into position before driving began. The short-radius piling segments, which closed the spaces between the main cells, were located by steel formers connected between the template and the previously-erected cell. They can be seen in the left foreground of Fig. 64.

After the driving of a pile cell had been completed, it was filled with earth, to about the level of the normal river surface, by means of a clamshell bucket. When the whole of the cells in a cofferdam had been driven, and partly filled in this way, the filling was completed by pumping dredged material directly into them. The surplus water flowed out of the cells through six 10-in. holes, which were cut in their river sides about 4 ft. from the top. The holes were closed when the cells were full of earth to their level, surplus water from the last 4 ft. of filling flowing over the top.

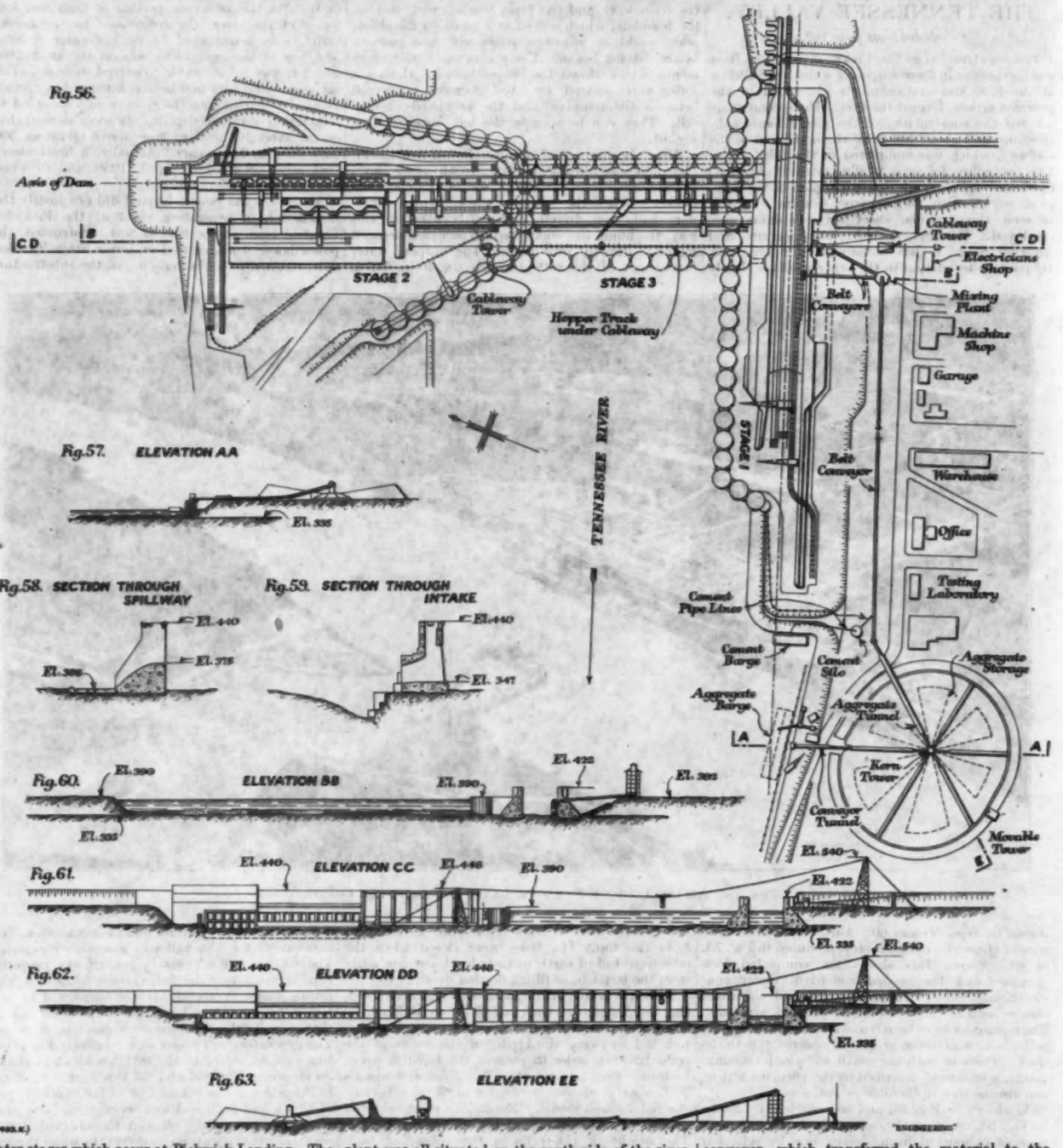
After the whole of the main cells had been filled, the intermediate connecting cells were filled by hydraulic pumping. Rows of weep holes were punched in every third pile on the inside of the cofferdams, in order to prevent the building up of hydraulic head in the cells. The holes were spaced 3 ft. apart and were left open until they became clogged up and closed. No displacement occurred in any of the cells during construction, or later. The height of the cells in the cofferdam built alongside the lock site was 55 ft. A total of 4,151 sheet piles, 15 in. wide and weighing 388 lb. each, was used in the construction of this cofferdam. All driving was done with two floating A-frame derricks equipped with steam pile hammers. One of these can be seen alongside the cofferdam in Fig. 53, on page 170, *ante*.

The three stages of the programme of construction which was followed are clearly shown in Figs. 56 to 63. As already mentioned, the procedure had the advantage of enabling the sheet-pile cells to be utilised for the building of Stage 2 cofferdam after Stage 1 had been completed, and later to be again used for Stage 3. The aerial view, Fig. 55, shows the state of affairs during the construction of the second cofferdam, when some two-thirds of the first had been dismantled. Apart from this important economy, however, the programme was laid out to fit in with the recurring periods of high and low water in the river, the cofferdams having necessarily to be constructed during low-water periods. The top of the cofferdams was at elevation 390, which it was not desirable to exceed, because, after the third cofferdam had been constructed, a greater height, by backing-up the river, would have led to inundation of the flood plain. Records showed that on an average the river rose above elevation 390 only once in four years. Actually, a flood above that level occurred in April, 1936, and drowned the first-stage cofferdam.

As the electric power demand did not justify the installation of generating plant at the Pickwick Landing Dam at the time it was constructed, the power-house work, carried on inside Stage 2 cofferdam, covered only the building of the substructure with the necessary intakes and draught tubes. The excavation for the tailrace was also completed. The station will ultimately contain six propeller-type units and as the tail-water level will be high during major floods, the power house will be protected by a bulkhead on the downstream side so that it will take the form of a box-like structure. The generators will be set at a relatively low elevation and connected to the turbines by short shafts. As shown in Figs. 56 and 63, the work carried out in Stage 3 was the completion of the spillway, part of which had been included in Stage 2. The third cofferdam completely blocked the channel, but it was possible at that stage to divert the water through the power-house intakes. Part of the spillway was also available for service and as the spillway crest is at elevation 378 the cofferdam had 12 ft. of freeboard to the good.

When the construction programme for the Pickwick Landing Dam was first planned, it was proposed to employ the floating concreting plant which had been used during the construction of the Wheeler Dam. This was dealt with in the fourth article of this series, on page 122, *ante*. Further study of the flood stages at the Pickwick Landing site, however, showed this to be impracticable. Although the floating equipment was well suited to the relatively slack-water conditions in the upper end of Lake Wilson, at the Wheeler Dam, it would have been difficult to operate under the varying

PICKWICK LANDING DAM ON THE TENNESSEE RIVER, U.S.A.



water stages which occur at Pickwick Landing. The success of the plant at the Wheeler Dam had also been dependent on the continuous supply of sand and gravel which it was possible to arrange for. This regularity could not have been maintained, as rises in the river would have suspended dredging operations for gravel. The project was accordingly abandoned, and the plant actually employed was of a type similar to that used in the construction of the Norris Dam, which was described on page 41, *ante*. Some items of the equipment were used on both works.

The concreting plant employed consisted of a circular storage dump for sand and aggregate, with a total capacity of 250,000 tons; a cement-blower system; a 110-ft.-high concrete mixing plant; and belt conveyors connecting the various parts. This plant was all situated on the south side of the river. As shown in Fig. 56, the circular storage dump was immediately downstream of the lock and the mixing plant behind the lock, close to the dam. The aggregates were brought to the site by barges from a grading plant situated a few miles upstream, the material being obtained from the river by dredging. When the barges arrived at the landing quay, alongside the storage dump, they were transferred to a 40-cub. yd. wooden hopper by means of a derrick equipped with a clamshell bucket. A photograph of the landing quay, showing one of the barges being unloaded, is reproduced in Fig. 65, on Plate XVI. The top of the receiving hopper can be seen in this illustration. One of the barges, and the derrick, are also indicated in Fig. 56.

The receiving hopper delivered to a 30-in. belt conveyor, which transferred the material to the top of a kern tower situated 425 ft. from the river and at the centre of the circular storage dump. This tower, and the conveyor feeding it, are well shown in the view of the dump given in Fig. 66, on Plate XVI. As indicated in Fig. 56, the belt conveyor passed through a tunnel in the neighbourhood of the receiving hopper. It will be clear from Fig. 65, that the purpose of this arrangement was to give a clear roadway around the dump. The conveyor had a capacity of 400 tons per hour. It delivered to a hopper at the top of the kern tower, which was provided with a swivel spout so that each type of aggregate could be delivered to an appropriate lower compartment. These lower compartments had delivery spouts by means of which each type of aggregate was then passed to the correct section

of the storage area. This area was, roughly, 500 ft. in diameter, but, as shown in Fig. 56, was not truly circular. The distorted form was adopted in order to provide storage sectors of different capacities, the amounts of each kind of aggregate required not being equal.

As the material was delivered by the kern tower spouts, which formed heaps around the tower base, it was distributed over the appropriate storage area by a 2¼-cub. yd. drag-line excavator. This was operated from a 60-ft. high travelling tower running on a rail track laid around the storage area. The tower is shown in Fig. 65 and the track can be seen both in this figure and in Fig. 66. The drag bucket was carried by a cable extending from the travelling tower to the central kern tower. At this latter it passed over a sheave which was mounted so that it was movable around the tower at a fixed height. An adjustable lead-in sheave, below a fixed sheave on the travelling tower, enabled the operator to regulate the height of the drag bucket to suit the amount of material on the stock piles. As shown in Figs. 56 and 66, the storage area was divided up by radial berm walls in order to keep the various classes of aggregate separate one from another.

The aggregate was transported to the mixing plant, situated some 1,510 ft. away, by a 24-in. belt conveyor running parallel to the river, as shown in Fig. 56. This was fed from a hopper at the base of the central tower, a series of shutters enabling the operator to charge the hopper with any particular type of aggregate as required. As the material stored towards the outer circumference of the storage area would not flow automatically into the hopper, it was brought nearer to the centre, when it was desired to work from stock, by reversing the direction of operation of the drag bucket. As shown in Fig. 56, the belt conveyor was located in a concrete tunnel where it passed under the stock pile; after that it was in the open. The last part of this long conveyor was sloped upward in order to reach the top of the mixing tower, as shown in Fig. 67, on Plate XVI. The conveyor, which consisted of four successive flights, travelled at 287 ft. a minute and had a capacity of 250 tons per hour. Communication was maintained between the mixing plant and the kern tower, so that the correct kind and quantity of aggregate could be delivered as required, by means of a combined light and sound signal system. A telephone connection was also provided.

Cement was also delivered to the site by barges which moored at a quay at the east end of, and at right angles to, the aggregate quay, as shown in Fig. 56. From the barges it was pumped into an elevated steel silo the position of which is indicated in Fig. 56; the silo can also be seen in Fig. 67. This silo, which had a capacity of 6,000 barrels, had previously been used on the Norris Dam works and is illustrated in Fig. 25, on page 50, *ante*. It was transferred to Pickwick Landing after the completion of the Norris Dam. The cement was discharged by gravity from the silo and conveyed to the mixing tower by a blower system operated by air at a pressure of 50 lb. per square inch. The system included two tanks, each with a capacity of 55 barrels. These were alternately loaded and discharged every five minutes with a quantity of cement equivalent to 30 barrels. One minute was required for loading and 4 minutes for discharging. As in the case of the aggregate kern tower, a signal system was provided between the mixing plant and the cement silo so that instructions could be given to the operator at the latter when to start and stop cement delivery. The run of the pipes of the cement-blower system is shown in Fig. 56.

The mixing plant situated near the axis of the dam, as shown in Fig. 56, is illustrated in Fig. 67. It was almost identical with the similar plant used at the Norris Dam and described on page 42, *ante*. It consisted of a tower with batching bins at the top; these discharged to mixers below which, in turn, fed a hopper at the bottom of the tower, from which the mixed concrete was delivered to the works. The starting of the charging of the cement and water batchers was controlled manually, but when the proper weights for the mix required had been delivered, the supplies were cut off automatically. The mixing plant was in communication with the men working on the dam and placing the concrete, through an electric-light signal system, which enabled start and stop messages, and instructions about the type of mix required, to be transmitted.

The concrete was delivered to the dam forms by belt conveyors, cableways and cranes, the particular means employed depending on the part of the work concerned, or the stage of progress. For building the navigation lock, a single flight of 30-in. belt conveyor, 245 ft. long, carried the concrete to a hopper located just inside the land face of the lock chamber. From this, it was delivered to 4-cub. yd. buckets carried on flat trucks running on rails and drawn by petrol-electric locomotives. The trucks were taken to points at which the buckets could be lifted by cranes and tipped inside the forms. This conveyor belt and hopper system is shown in Figs. 56 and 60. For the second and third stages of the work, which covered the power-house substructure and part of the spillway and the main spillway section, respectively, a cableway 1,500 ft. long was erected parallel to the axis of the dam. This is shown in Figs. 55, 61 and 62. The cable, passing over the works, can also be seen in Fig. 49, on Plate XIII, *ante*. It was supported between a head tower, 150 ft. high, on the south bank and a tail tower, 110 ft. high, located at the south end of No. 2 cofferdam. Bottom-dumping buckets, of 4 cub. yd. capacity, travelled on the cable and were loaded from a hopper on the south bank. They delivered to a hopper situated in front of the tail tower. From this, buckets, carried on flat trucks, were charged and transferred to the place required by petrol-electric locomotives. The concrete was finally placed by cranes, in the same way as that employed in the building of the lock.

The Pickwick Landing Dam was constructed under the general supervision of the same officials as have already been mentioned in connection with the Norris and Wheeler Dams. Those immediately associated with the work included Mr. A. L. Pauls, who served as project engineer, Mr. R. F. Olds, acting construction engineer, and Mr. James E. Walters, acting construction superintendent.

LITERATURE.

Physical Science in Art and Industry. By DR. E. G. RICHARDSON. St. Hugh's School, Bickley, Kent: English Universities Press, Limited. [Price 15*s.* net.]

THE application in industry of the discoveries and methods of physical science is one of the most notable tendencies of this century. Its value is evident, directly in the improvement of essential services and the enhanced range of amenities available to the community as a whole; and indirectly, by the organisation of scientific research on a scale reflecting confidence in the development of industrial processes on an increasingly stringent physical basis. On the one hand, therefore, exists a section of society—professional physicists, research workers, engineers and technicians in industry—now numerically greater than ever before, for whom the exploitation of scientific facts and methods is of predominant interest. On the other is the non-technical public, served by science at every hand and in every aspect of its daily life, often unsuspecting the extent of such service but rarely unappreciative or unwilling to know more about it. A cordial reception is thus assured for a book, like this by Dr. Richardson, which surveys practically the whole field of technical activity and presents the basic physics in a simple, readable way that is attractive to the layman and yet instructive to the specialist.

The diversity of arts and industries to which experimental physics actively contributes is perhaps the most outstanding point brought out by Dr. Richardson's book. Without exhausting all such applications, he deals in turn with fifteen major activities, many of which embrace several related but distinct technologies. The more obvious subjects for physical research—locomotion by land, sea and air, communications by wire and radio, textiles, building materials, acoustics and mining—naturally demand a chapter apiece, despite a degree of restraint amounting in some directions to drastic curtailment. The author has contrived, nevertheless, to say at least something about every impact of physics upon these industries and to select, with commendable skill, matters of primary importance for treatment in sufficient detail to be genuinely informative. The rest of the book covers a range of physical applications with which all but a few specialists will be largely unfamiliar, but which, for that reason, will be found the more interesting by the majority of technical readers. It treats of pottery, cooking, farming, painting, archæology, architecture and music; activities that for centuries have been arts, governed largely by tradition, and only lately have been gradually transformed into sciences by the introduction, often with unquestionably good results, of such outlets for physics as Dr. Richardson describes.

Since it is a manifest impossibility to cover all the industrial applications of physics in a single volume, some readers may consider that their own particular subjects have received less attention than their industrial importance warrants. The explanation is simply that no one man, not even a Dr. Richardson, can know all about everything. The wonder, rather, is that within the compass of 300 pages he has condensed so much factual information without using mathematics, or, indeed, departing from an enviably lucid, yet easy style of writing. His confident exposition of a remarkable variety of subjects, no less than the extent of his original contributions to applied physics, are more than sufficient assurance that this book is no mere journalism but a reliable treatise which can be quoted as an authority, used as an introductory text-book, or simply read with a gratifying sense of well-spent relaxation.

Mechanics of Liquids. By PROFESSOR RALPH W. POWELL. New York: The Macmillan Company. London: Macmillan and Company, Limited. [Price 15*s.* net.]

THE author of this attractively produced book, who was formerly a hydraulic engineer engaged on watershed conservancy, and is now associate professor of mechanics in the Ohio State University, brings a valuable combination of practical and academic experience to the task of presenting the elements of hydraulics in the light of the developments in fluid dynamics that have contributed to, or been stimulated by, the growth of aeronautics during the past 25 years. These researches, gradually replacing the empiricism of classical hydraulics by a solid theoretical foundation, ought to figure prominently in the initial stages of modern hydraulic teaching.

Professor Powell's book presents the essentials of liquid mechanics as a short course of reading, preparatory and complementary to the engineering aspects of hydraulics. It differs from the best of existing standard texts less in the introduction of recent advances, since these are fully appreciated by previous writers and accorded full recognition in the revised editions of their works, than in the point of view from which he has surveyed the whole field of fluid mechanics and selected for emphasis those elements which serve to exemplify the work of Reynolds, Prandtl, von Karman and Nikuradse. He proceeds from the simple to the complex in chronological order, from the hydrostatics of the ancients to the hydrodynamics and dimensional analysis of the moderns, treating always of the liquid to the exclusion of hydraulic machines. The first six chapters deal conventionally, though in less than usual detail, with hydrostatics, the fundamentals of hydraulic flow in pipes and channels, and the characteristics of orifices, nozzles and weirs. The quantitative study of viscosity and its effects is confined to the last three of the eight chapters. One of these discusses hydraulic models, which have been widely used by American hydraulic engineers, though not to the exclusion, as the author seems to imagine, of comparable first-rate work in this country. On other points of detail, the book can be justly criticised, while the inclusion of too large a proportion of elementary matter will detract from its appeal to experienced engineers of post-graduate standard. Regarded as its author intended however, as an elementary text for students of hydraulic engineering or physics, approaching fluid mechanics for the first time, the book has much to commend it.

THE ENGINEERING OUTLOOK.

IV.—ELECTRICAL ENGINEERING.

(*Concluded from page* 185.)

The Light Industry.—The transition from peace to war-time conditions undoubtedly occasioned greater dislocation in the light section of the electrical engineering industry than in the heavy section. Nevertheless, the employment figures in the manufacture of electric cables, apparatus and lamps, given in Table III, below, indicate that a very high level of activity was maintained in the industry as a whole. In the case of certain branches, however, notably the radio industry, the maintenance of activity was achieved by a considerable expansion in the range of products. The reason was, of course, that many sections of the industry are dependent on retail spending of a luxury or semi-luxury character, and therefore were hit by the reduction of incomes brought about by increased taxation and saving. It must not be forgotten, of course, that the industry covers a wide range of products and some sections, for example, the electric-lamp manufacturers, have been very busy as a result of the need for the adoption of new lighting systems resulting from the black-out regulations and the general extension of night work. The light section of the electrical

TABLE III.—*Employment in Electric Cable, Apparatus, Lamps, etc., Industry.*

Date.	Insured.	Unemployed.	Number Employed.
July, 1930 ..	102,620	8,783	93,837
1931 ..	108,340	16,057	92,283
1932 ..	117,490	10,310	107,180
1933 ..	125,570	15,843	109,727
1934 ..	133,280	10,260	123,020
1935 ..	142,200	11,511	130,689
1936 ..	151,830	8,736	143,094
1937 ..	177,670	6,653	171,017
1938 ..	179,820	13,461	166,359
1939 ..	185,290	8,301	176,989
1940 ..		5,675	

engineering industry as a whole has been particularly successful during 1940 in export markets, exports of electrical goods and apparatus for the first 11 months of the year amounting to 12,397,000*l.*, compared with 10,287,000*l.* for the corresponding period of 1939 and 12,309,000*l.* for the first 11 months of 1938. No division of this figure into individual products is possible.

(i) *Insulated Wire and Cables.*—Most cable manufacturers managed to maintain or expand both the volume of work on hand and the profits earned during 1940. Following the outbreak of war, there was quite a substantial decline in the normal civil demand, since municipal and public electricity undertakings restricted considerably their schemes for mains extensions. Most manufacturers, however, were soon able to offset this decline by increased work for military and naval purposes and, towards the end of 1940, with the intensification of rearmament generally, the volume of such work achieved very substantial proportions. The chairman of Callender's Cable and Construction Company, Limited, for example, was able to state, in March, 1940, that "the effect of the declaration of war was felt particularly in our home contract work. We have received substantial orders for super-tension cables but, generally speaking, that side of our business has slackened off. During the year, our business in rubber-insulated ship wiring cables reached the highest level . . . Since September, practically the whole of our output of ship wiring cables has been made to the requirements of H.M. Navy." The chairman of the General Cable Manufacturing Company stated, in December, that his company had been engaged almost exclusively on large Government contracts for the War Departments, which had necessitated running most of the plant twenty-four hours a day throughout the year. Most of the other manufacturers also reported a very heavy volume of work on hand for Government departments.

In spite of this concentration on war work, a satisfactory volume of export trade appears to have been maintained, at least during the earlier part of 1940, though no statistics of exports are available after the end of 1939. British exports of insulated wire and cable are shown in Table IV, on this page,

TABLE IV.—*United Kingdom: Exports of Insulated Wires and Cables.* (£000.)

1933	...	1,614	1937	...	4,397
1934	...	2,158	1938	...	4,320
1935	...	2,685	1939	...	3,825
1936	...	2,947	1939 Jan.-Aug.		2,816
			,, Sept.-Dec.		1,011

up to the end of 1939. It is not possible to include the value of exports from other countries, as has been done in previous years. It will be seen that, for the first four months of the war, exports were at a rate equivalent to just over 3*l.* million per annum, which, though below the level for the years 1937 and 1938, was higher than for any of the preceding four years. Moreover, on the basis of experience in the engineering industry as a whole, there is reason to suppose that exports were exceptionally low in September and October, 1939, and that some recovery took place later. This is confirmed to some extent by reports from individual companies, which record increased orders from the British Empire and China.

(ii) *Wireless.*—Most firms in the wireless industry have maintained a high level of activity, though in many cases this has been achieved mainly by broadening the range of products and undertaking a substantial volume of Government work. Home sales of wireless receivers have been reduced, both on account of the reduction of purchasing power and the restriction of raw material supplies to manufacturers. In the case of the more popular makes, the latter factor was probably the most important in reducing output, and the public found in several cases that their orders could not be met without a substantial delay. Many manufacturers suffered from the cessation of the television service, since 1939-40 was expected to be the first year in which really important sales of television receivers would be effected. Manufacturers therefore built up considerable stocks of these receivers in the autumn of 1939, only to find their market completely destroyed on the outbreak of war. In spite of repeated representations to the Government, any resumption of the television service before the end of the war seems unlikely.

In addition to difficulties arising from the restriction of raw materials, the industry has also had to contend with man-power problems. The decision of the Royal Air Force to enlist a large number of men between the ages of 18 and 50 with a knowledge of radio apparatus, came as a considerable surprise, since many of the industry's employees were reserved at 25 or 30. These reservations remained in force, but applied only to compulsory calling up, and several firms lost a considerable number of men by voluntary enlistment. Another development which caused some dislocation was the need to obtain a permit for each valve used exceeding 10 watts dissipation. After a short time it was arranged that wholesalers and retailers should be enabled to obtain collective permits for such valves, but it was still necessary for every purchaser of a set containing these valves to obtain a permit to use them. Several firms therefore decided that the best course was to redesign their sets to take other valves.

In April, the Board of Trade, at the request of the Radio Manufacturers' Association, prohibited the importation of wireless apparatus (including valves) and parts. The value of such imports had amounted previously to about a million pounds per annum. It was contended that these imports were unnecessary and were also unfair to British manufacturers at a time when they were affected by the rationing of raw materials and a shortage of labour. In May, it was announced that the price of radio-gramophones, wireless receivers, components and accessories were to be controlled as from July 10, goods for export being exempted. Later in the year, however, the decision to apply the higher rate of purchase tax to radio apparatus caused a substantial price increase, which probably reduced still further the demand from the home market.

Export demand, on the other hand, has been very satisfactory as a result of the elimination of competition first from Germany and then from Holland, two of the most important competitors of the British industry in peace time. As a result, the industry has been quite incapable of meeting the volume of orders received and steps have been contemplated for a substantial re-organisation, including the pooling of resources by several companies. In order to realise the position, it is worth bearing in mind that the value of exports from Germany and Holland together, was over four times those from the United Kingdom in 1938 and, although the United States is undoubtedly securing a substantial part of the trade of these two countries, she could only fill the gap by more than doubling normal exports. Towards the end of 1940, the export group of the Radio Manufacturers' Association decided not to be officially represented at the trade exhibition in South America, since it was felt that there was no justification for seeking orders until the capacity for dealing with them could be increased. The industry undoubtedly has a real opportunity of permanently improving its position in export markets, a matter of particular importance in view of the fact that, quite apart from the war, there were reasons for supposing that home sales were likely to settle down at a level well below that of the last two or three years. Every effort should, therefore, be made to overcome the difficulties arising from shortage of raw materials and labour.

There is a danger that inability of the United States and British industries together to supply the world demand may result in a tendency for other countries to start manufacture. It is proposed, for example, to start production in India, which is one of the most important potential markets for British sets. A private firm, the National Radio and Engineering Company, has been formed with a capital of Rs. 1,000,000 and intends to produce 10,000 sets per annum. It is hoped to start production by the middle of 1941, and the company has already purchased premises at Mahalakshmi, Bombay. Initially only medium-wave sets will be produced, for local and all-India reception, but later it is proposed to make short-wave sets. British exports of radio sets up to the end of 1939 are shown by value in Table V, below. This shows

TABLE V.—*United Kingdom: Exports of Wireless Apparatus (incl. Valves).* (£000.)

1933	...	1,340	1937	...	1,826
1934	...	1,574	1938	...	1,976
1935	...	1,609	1939	...	1,250
1936	...	1,501	1939 Jan.-Aug.		975
			,, Sept.-Dec.		275

that there was a substantial decline in exports in 1939 (and this was common to all exporting countries), while, in the first four months of the war, exports were at the rate of about 825,000*l.* per annum.

(iii) *Telegraph and Telephone Apparatus.*—The steady increase in the number of private telephone subscribers, which has been a feature of recent years, was brought to an end by the outbreak of war. A good deal of work was necessary, however, in connection with the evacuation of Government departments and private firms from London and other large cities, and in connection with the A.R.P. organisation, while, in addition, a great deal of equipment has been required for the Forces. Even before the outbreak of war, there was ample scope for further development of the telephone services of this country, and this scope will be still further increased by the restrictions which have been imposed on new developments. According to some interesting statistics recently published by the American Telephone and Telegraph Company, Great Britain possesses only 7·84 per cent. of the total of 41 million telephones in the world, the United States having 48·56 per cent. and Germany, 10·09 per cent. Exports of telephone and telegraph apparatus up to the end of 1939 are shown in Table VI, on the opposite page, which shows that, in the first four months of the war, exports amounted to about 1·4*l.* million per annum, compared with 2·9*l.* million in the peak year, 1938.

(iv) *Incandescent Lamp Bulbs.*—In the case of incandescent lamp bulbs, there are also excellent prospects in export markets since, prior to the war, the three principal exporting countries were Germany, Holland and Hungary, which together

accounted for about 60 per cent., by value, of the total world trade. In the first four months of the war, British exports fell to a rate equivalent to about 400,000*l.* per annum, which compares with 594,000*l.* in 1938 and 652,000*l.* in 1937. There is reason to believe, however, that some recovery has since taken place. In the home market, the black-out regulations have to some extent altered the type of demand, but it seems probable that there was no substantial decline in the total volume of sales. Thus, while lighting business, and possibly also certain special categories such as sales of bulbs for vehicle lights, have fallen off, there has been an

TABLE VI.—*United Kingdom: Exports of Telephone and Telegraph Apparatus.* (£000.)

1933	...	1,074	1937	...	2,112
1934	...	1,108	1938	...	2,917
1935	...	1,722	1939	...	2,156
1936	...	1,765	1939 Jan.-Aug.		1,684
			,, Sept.-Dec.		472

increased demand for improved factory lighting, particularly in view of the extension of night work. There has also been, of course, a steady improvement in the standard of factory lighting, and in October the Ministry of Labour decided to give effect to the recommendations of the Departmental Committee on Lighting in Factories which had been published some three months previously. The Regulations since made in pursuance of this decision were summarised on page 153, *ante*.

(v) *Batteries and Accumulators.*—In spite of the enormous demand for torch batteries in the early stage of the war, British manufacturers managed to maintain exports during the period September to December, 1939, at the rate of about 120,000*l.* per annum (see Table VII). In the case of accumulators, the figures given in Table VIII include

TABLE VII.—*United Kingdom: Exports of Incandescent Light Bulbs.* (£000).

1933	...	427	1937	...	652
1934	...	508	1938	...	594
1935	...	571	1939	...	531
1936	...	596	1939 Jan.-Aug.		394
			,, Sept.-Dec.		137

TABLE VIII.—*United Kingdom: Exports of Batteries and Accumulators.* (£000.)

Batteries.					
1933	...	205	1937	...	192
1934	...	192	1938	...	163
1935	...	177	1939	...	142
1936	...	183	1939 Jan.-Aug.		100
			,, Sept.-Dec.		42
Accumulators.					
1933	...	517	1937	...	597
1934	...	525	1938	...	584
1935	...	505	1939	...	530
1936	...	565	1939 Jan.-Aug.		(*a*)
			,, Sept.-Dec.		(*a*)

(*a*) Not available.

all types of accumulators and parts, and it is not possible to show exports during the first four months of the war on this basis. Exports of complete accumulators, however, totalled 86,000*l.* for the period September to December, 1939, compared with 175,000*l.* for the first eight months of the year. The outbreak of war, therefore, made little change in the rate of export.

In spite of arrangements for increased production of batteries, it was felt that there was a danger of shortage during the winter of 1940-41, and the Board of Trade, therefore, arranged to license a certain quantity of imports. At the same time, an appeal was made to the public to exercise the maximum possible economy in the use of torches. Although undoubtedly much less use was made of torches out of doors in the black-out, many people had developed the habit of using them as a means of permanent illumination in air-raid shelters.

In November, the Board of Trade made two orders fixing maximum retail selling prices for the various kinds of electric torch batteries in common use. This presented some difficulty, since it was not possible to fix a single price for all batteries of a given size, because the smaller British manufacturers (many of whom had started business since the beginning of the war in an effort to supplement supplies) could not, in most cases, make them as cheaply as the established firms. Moreover, the prices of most imported batteries were considerably higher than those of any British-made batteries. A scale of prices for the various types was, therefore, drawn up, which fixed the prices in the case of the smaller British manufacturers at ½*d.* to 1½*d.* above that of the established firms, while imports from the United States were fixed at anything up to 3½*d.* higher, according to the type of battery.

During the past year, as a result of experiments conducted by the Salvage Department of the Ministry of Supply, several firms have begun to recover waste materials from used batteries. It is claimed that 100 tons of high-tension batteries will yield about 10 tons of zinc, 3 tons of carbon rods, 10 tons of pitch, 3 tons of pulverised carbon, 1 ton of brass and copper, 10 tons of cardboard, and 50 tons of a mixture of graphite, manganese ore, etc.

Petrol rationing has provided an impulse towards the increased use of accumulator-driven vehicles, though the expansion has not perhaps been as large as was at first hoped for. The secretary of the Electric Vehicle Association of Great Britain, however, stated in May, 1940, that approximately 1,000 battery electric vehicles for commercial work had been added to the 5,000 already existing on the outbreak of war.

(vi) *Meters and Instruments.*—As shown in Table IX, United Kingdom exports of meters and

TABLE IX.—*United Kingdom: Exports of Meters and Instruments.* (£000.)

1933	...	259	1937	...	438
1934	...	302	1938	...	496
1935	...	376	1939	...	507
1936	...	423	1939 Jan.-Aug.		348
			,, Sept.-Dec.		159

instruments in the first four months of the war were valued at 159,000*l.*, equivalent to 477,000*l.* per annum. This compares with 496,000*l.* in 1938 and 438,000*l.* in 1937.

THE LOSS OF THE "PRESIDENT."

JUST a century ago, in March, 1841, the paddle-steamer President was lost with all hands, and thus occurred the first great tragedy in the history of transatlantic steam navigation. The ship had left New York on March 11. Next day, she was sighted during a heavy gale by the sailing ship Orpheus and was then between Nantucket Shoals and St. George's Bank. After that, nothing more was heard of her, but it is presumed that she foundered during the night of March 12. The President was the sixth of the pioneer vessels which, during 1838-40, inaugurated direct transatlantic steam navigation between this country and the United States, and belonged to the British and American Steam Navigation Company, founded in London through the efforts of the American lawyer and business man, Junius Smith. In 1838, the company had sent the little Sirius on her historic voyage, and in 1839 had placed the much larger British Queen in service. The British Queen was the only real rival of the famous Great Western. Larger than either of these vessels, the President was built on the Thames at Curling and Young's yard at Limehouse, but was engined by Fawcett, Preston and Company, of Liverpool. Her upper deck was 243 ft. long, her keel 220 ft.; she had a breadth of 41 ft. within the paddle boxes and a breadth of 68 ft. over all. By measurement, she was of 2,366 tons. Her side-lever engines were of 540 nominal horse-power. Her timbers were of oak, and the planking of fir. Her frames were solid to the bilge and were diagonally fastened fore and aft with iron and wood. There was no question of the soundness of her construction. With one funnel, schooner rig and her sides painted like a man-of-war's with gun ports, she presented a handsome appearance, though it appears that she did not appeal to the eye of a seaman as did the Great Western. While the figure-head of the British Queen represented Queen Victoria, that of the President was an effigy of Washington.

It was on her third voyage that the President was lost. Her first double crossing between Liverpool and New York had been made in August and September, 1840. She was then under the command of Lieut. R. J. Fayrer, who, in 1839, had been captain of the Liverpool. The slow passages that the ship made (16½ days each way) led to Fayrer being relieved by Captain Keane, under whom the ship made her second voyage, but with no improvement in her speed. This second double crossing was made in October and November. On the homeward voyage of this trip, she left New York on November 1, only to be forced to return to port five days later by stress of weather. Eventually she reached Liverpool on November 27, after another passage of 16½ days. Her third and last round voyage began on February 10, 1841. She was then in charge of Lieut. Richard Roberts, who had commanded both the Sirius and the British Queen, while her chief engineer, Edward Peterson, had been engineer of the latter vessel. The competence of Roberts and Peterson was never in doubt; yet, on the last outward voyage, the President took no less than 21 days to cross. After a stay in New York of about a week, she left, as stated above, on March 11, and from the time the Orpheus lost sight of her nothing more became known.

By the beginning of 1841, the Western Ocean had been crossed and recrossed by steam more than forty times; twice by the Sirius, three times by the Royal William, seven times by the Liverpool, eight times by the British Queen, twice by the President, seventeen times by the Great Western, three times by the Britannia, and twice by the Acadia. Both of the last-named vessels ran to Boston, via Halifax, and not to New York. For the British and North American Steam Navigation Company, the loss of the President was disastrous; the British Queen was immediately sold to the Belgian Government, the company went into liquidation and Junius Smith had no further share in the great enterprise he had done so much to foster. Smith, of course, was not the only individual to visualise the possibilities of transoceanic passage by steam but it was undoubtedly his imagination, persistence and business ability which gained publicity and support for the project. Born at Plymouth, Massachusetts, on October 2, 1780, Smith graduated at Yale in 1802 and, after further study, practised at the New Haven Bar. It was as a lawyer that he came to England, to prosecute claims against the Government for the capture of American sailing ships. Here he combined business with the law and became the representative of his brother's New York importing and exporting firm, Wadsworth and Smith. On his brother's death, the management of the firm was taken over by a nephew, Henry Smith, to whom many of Junius' most interesting letters were addressed. The great project appears to have definitely entered his mind first in 1832-3, and from that time neither indifference, scepticism nor rebuff could turn him from his task. When Dr. Dionysius Lardner was preaching the impracticability of sending steam ships direct to New York, Smith wrote to his nephew that Dr. Lardner was "a perfect Quack and embarked in the old Valentia Steam Company, now defunct for twelve years. He knows nothing upon the subject but what he picks up here and there like an old ragman." After the loss of the President, he returned to America and endeavoured to arouse the interest of business men there, but failed.

He then applied his energies in a totally different direction and tried to introduce tea-planting in South Carolina. As a Northerner, he was suspected as being a friend of the negroes and a critic of the slave system, and one day in December, 1851, his house was entered and he was severely assaulted. From this experience he never recovered and two years later, on January 23, 1853, he died in an asylum in New York, at the age of seventy-two. When his British Queen and President were both in service, he had dreamed that his services to Great Britain would be rewarded with a knighthood. The only honour that came to him, however, was an LL.D., granted in 1840 by his old University, the president of which wrote to him that it was given in recognition of his services to Great Britain and the United States, since it was his "enterprising projection, execution and completion of that novel method of navigating the Atlantic which brings the two countries in such eventual proximity to each other."

ELECTRIC HAND DRILLS.

MESSRS. S. WOLF AND COMPANY, LIMITED, LONDON.

FIG. 1.

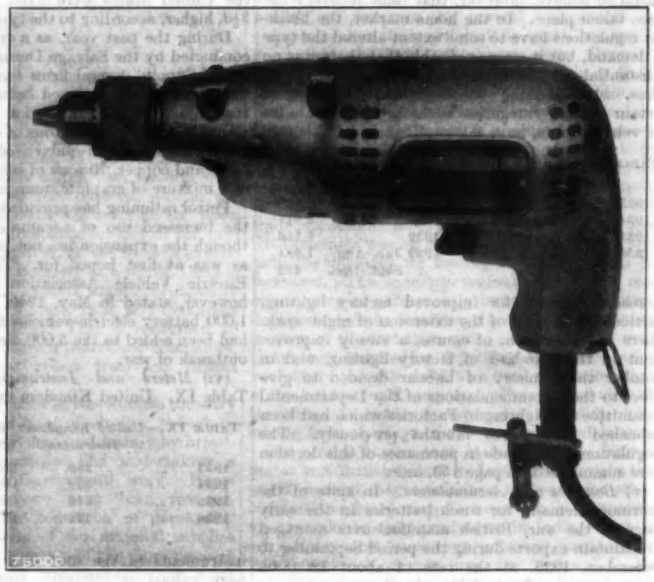


FIG. 2.

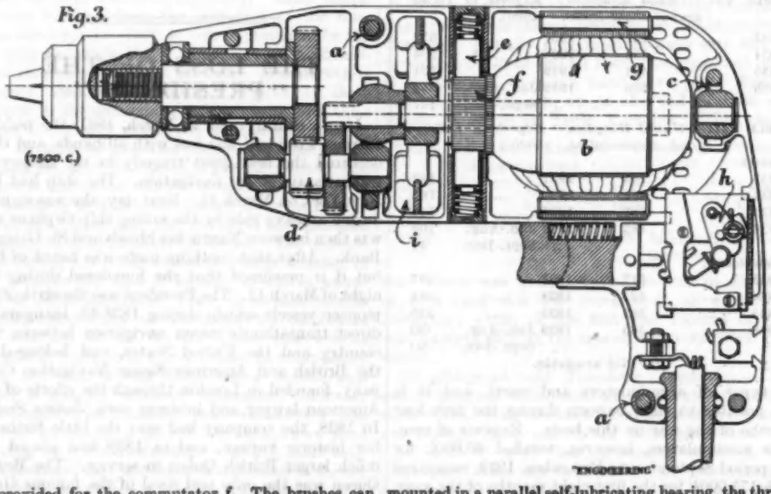
ELECTRIC HAND DRILLS.

THE electric hand drill shown in Figs. 1 to 3, herewith, while following common practice in that the power is transmitted through double-reduction gearing, has a number of unusual features. Perhaps the most characteristic of these is that the casing is split in the longitudinal plane and the halves may be opened, as shown in Fig. 1, to expose the whole of the working parts, which are mounted in the lower half. The assembled drill is seen in Fig. 2, in which the bolts fastening the halves together are visible, and a drawing of the lower half, with some of the working parts in section, is reproduced in Fig. 3. The drill has been designed for light duty and is made in two sizes, the first for general drilling work of an intermittent nature up to holes $\frac{1}{4}$ in. in diameter in metal and $\frac{1}{2}$ in. in wood, and the second for drilling holes in mild steel up to $\frac{3}{8}$ in. in diameter or $\frac{1}{2}$ in. in wood. Both sizes bear the name "Dartdrill" to distinguish them from other types listed by the manufacturers, Messrs. S. Wolf and Company, Limited, Pioneer Works, Hanger-lane, London, W.5.

The $\frac{1}{4}$-in. drill runs at a drill-spindle speed of about 1,900 r.p.m. unloaded, and at approximately 940 r.p.m. on full load. On light load the current consumption is about 110 watts, rising to about 240 watts on full load, and this consumption makes it practicable to run the drill from an ordinary lighting socket. The motor is of the universal type, suitable for either direct current or single-phase current in the two ranges 100/120 volts and 220/250 volts. With single-phase current the frequency range covered is from 25 cycles to 60 cycles. A 50-volt machine can also be supplied for single-phase current only. The casing is $2\frac{1}{16}$ in. in diameter externally and the overall length is $8\frac{1}{16}$ in. The net weight is 4 lb. The $\frac{1}{2}$-in. drill has a casing of the same diameter, but has an overall length of $9\frac{1}{16}$ in. and a net weight of 4 lb. 7 oz. The consumption is about the same as that of the lighter tool, though the spindle speeds are lower, namely, about 950 r.p.m. when running light and about 475 r.p.m. under full load.

Referring to Fig. 3 for details of the construction, it will be seen that the halves of the casing are centred by dowels *a*, through which two of the connecting bolts pass. The spindle of the armature *b* is mounted in self-aligning bearings, which are made of a semi-porous oil-retaining metal and are surrounded by oil-soaked felt rings *c*, being thus self-lubricating. Under normal conditions, the lubricant is sufficient for 12 months' service, but, in any case, it may be renewed by soaking the felt pads in a good-quality spindle oil. The bearings are prevented from rotating by steel keys. The second-motion shaft *d* is carried in similar bearings. The armature is former-wound and two carbon brushes *e* are provided for the commutator *f*. The brushes can be replaced from the exterior without breaking the joint of the casing, the position of one of them being indicated at the top of Fig. 2. The average brush life is 300 working hours. They must be replaced when worn down to $\frac{1}{16}$ in. thick. To dismantle the whole of the electrical parts, when the casing has been opened, the armature and spindle, with the bearings, are withdrawn by slightly tilting the field coils *g*, the coils being then removed complete with the brush holders. The switch is indicated at *h*. It is of the single-pole double-break type, operated by a double-action plunger and can be detached after removing two screws. The armature spindle carries a fan *i*, which delivers a strong current of air through the windings. The positions of the inlet and outlet ventilating holes are shown in Fig. 2.

Fig. 3.



The driving pinion is formed on the end of the armature spindle and meshes with a gearwheel on the second-motion shaft, which carries an adjacent pinion meshing with the chuck spindle. The gears are of heat-treated nickel-chrome steel. No special arrangements for their lubrication are required, a thin coating of good grease being all that is necessary. Carbon dust, etc., may be removed by occasionally subjecting the drill, preferably while running, to a blast of clean dry air from a compressor or hand blower, applied to the ventilation ports. The chuck spindle is mounted in a parallel self-lubricating bearing, the thrust being taken by a single-row ball bearing. The chuck is of the three-jaw keyed type, and the chuck key is carried in a clip on the cable sleeve, as shown in Fig. 2.

FORD MAGNESIUM-ALLOY FOUNDRY.—Particulars of a new foundry for the production of magnesium-alloy castings, which is being built at the River Rouge Works, Michigan, U.S.A., of the Ford Motor Company, are given in a recent issue of *The Iron Age*. The installation, which is now practically completed, occupies 100,000 sq. ft. of space and will be employed on the production of castings totalling 110,000 lb. a month. The alloy is to consist of from 6 per cent. to 9 per cent. of aluminium, 1½ per cent. to 3 per cent. of zinc, and the remainder magnesium, which metal will be supplied by the Dow Chemical Company, Midland, Michigan. Nineteen gas-fired melting furnaces, having a combined capacity of 500,000 lb. a month, have been installed, so that the foundry would be capable of supplying the requirements of outside firms. Four of the furnaces will each have a capacity of 2,000 lb., four a capacity of 400 lb., seven a capacity of 200 lb., and four a capacity of 100 lb. The last four furnaces will be employed on refining operations. In addition, core-baking and annealing furnaces are provided. The new foundry will employ about 350 men.

CELLULAR SHEET-STEEL FLOORING.

MESSRS. H. H. ROBERTSON COMPANY, PITTSBURGH, PA., U.S.A.

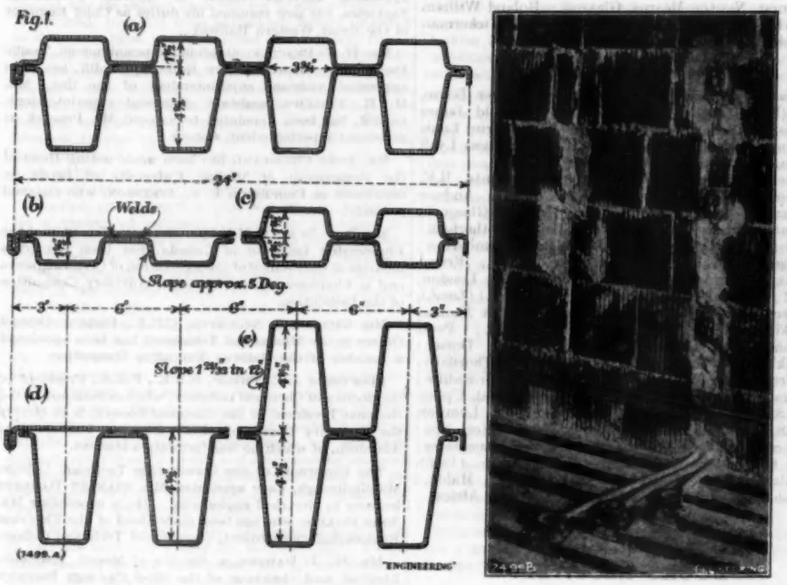


FIG. 3. CABLE CONNECTING BOXES.

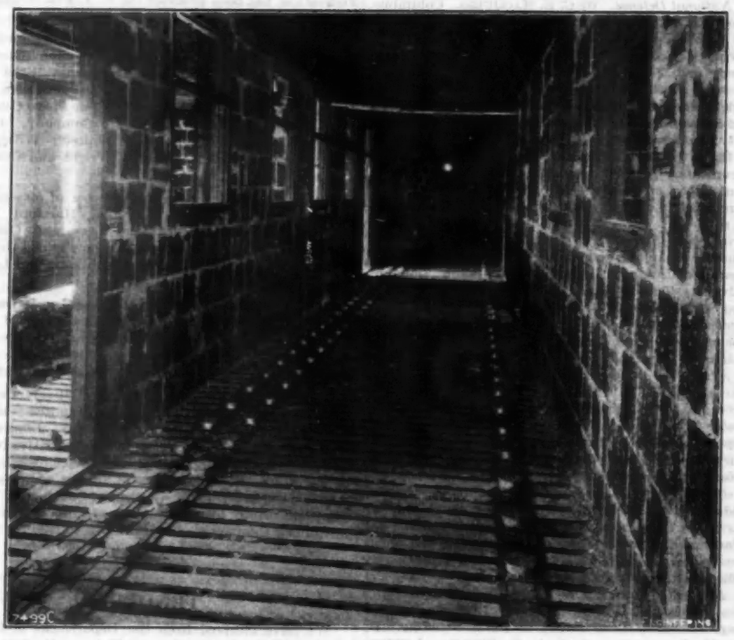


FIG. 2. ACCESS BOXES FOR ELECTRIC CABLES.

CELLULAR SHEET-STEEL FLOORING.

THE form of cellular sheet-steel flooring described below has been employed for some time in the United States but, so far as we are aware, has not yet been tried in this country. The Robertson Keystone beam steel floor, as it is called, is manufactured by the H. H. Robertson Company, Pittsburgh, Pennsylvania, U.S.A., and was primarily developed in order to lighten the dead load on the foundations of tall buildings and to reduce the time required for their erection. It consists of deeply-corrugated steel sheets assembled so that the corrugations form a series of hollow beams. Five typical assemblies are shown in cross-section in Fig. 1, herewith. In this figure, the arrangement shown at (*a*) is the standard one and consists of a bottom sheet with four deep corrugations and a top sheet with four shallower corrugations, the sheets being spot-welded together in lines at the points indicated. The two sheets are shown separated, but, actually, they are in contact over the areas between the corrugations. The total width of this standard unit is 24 in.

It will be obvious that, since two different elements are employed, four other arrangements are possible to meet different conditions of load, etc., while it will be equally clear that the load-carrying capacity can be altered within wide limits by varying the thickness of the sheets. The top and bottom sheets, moreover, may be of the same thickness or different thicknesses. The arrangement (*b*) in Fig. 1, is obviously suitable for very light loads; arrangement (*c*) will carry heavier loads; the arrangement (*d*) is capable of carrying still heavier loads, though not, of course, as heavy as those carried by arrangement (*a*); while arrangement (*e*) has so high a load-carrying capacity that it is rarely required. The overall width in arrangements (*b*) to (*d*) is generally the same as the standard design, namely, 24 in., but, in order to facilitate handling, the units of arrangement (*e*) are made 12 in. wide, overall. It will be noticed, referring again to arrangement (*a*), that the finish of the upper sheet differs at the edges. With the heavier-gauge material, both edges are flanged as shown at the right hand, the flanges of adjacent units butting one against the other and the joint being welded after erection in the building. With lighter sheets, however, it is possible to fold one edge, as shown at the left hand. Into this fold the right-hand flange of the next unit is inserted, thus locking the units laterally.

In view of the number of possible combinations of arrangement and plate thickness, the only practicable method of comparing the load-carrying capacity of the five arrangements shown in Fig. 1 is to take a constant span and a constant plate thickness, even if, in some cases, the results do not seem to be practicable. In Table I, below, the span is taken as 11 ft.

TABLE I.

Reference in Fig. 1.	Weight per sq. ft. of Floor.	Total Load Capacity, lb. per sq. ft., uniformly distributed.	Deflection.
	Lb.		In.
(*a*)	20·8	720	0·29
(*b*)	14·0	155	0·90
(*c*)	15·6	350	0·62
(*d*)	18·5	550	0·35
(*e*)	25·8	1,270	0·22

and the thickness of both top and bottom plates as 0·141 in. The loadings stated limit the tensile stress to 16,000 lb. per square inch.

The results in Table I indicate, for arrangement (*a*), that this is suitable for average loading on spans from 12 ft. to 16 ft., the deflection being a normal one. The deflection for arrangement (*b*), however, is on the large side and indicates that it is not suitable for the span selected. As a matter of fact, the span should not exceed 10 ft., nor the load exceed 200 lb. per square foot. Arrangement (*c*), again, has a rather large deflection, but the construction is considered suitable for loads between 400 lb. and 75 lb. per square foot on spans of from 6 ft. to 12 ft. Arrangement (*d*) has been used most successfully where the loads were not in excess of 125 lb. per square foot, on spans ranging from 10 ft. to 15 ft. Arrangement (*e*) will carry a heavier load on the given span than is likely to be required. With a span of 20 ft., a load of 385 lb. per square foot will give a deflection of 0·72 in. The above results will be modified, of course, by the thickness of the material, apart from the arrangement of the elements and the span. Thus, when both top and bottom plates are 0·05 in. in thickness and the weight per square foot is only 7·5 lb., the standard arrangement (*a*) has a load capacity of 200 lb. per square foot on a span of 11 ft., with a 3 in. bearing at each end and a deflection of 0·23 in.

The results of very careful and extended tests, for the most part on arrangements (*a*) and (*d*), have been published by the Bureau of Standards, Department of Commerce, U.S.A. With these two arrangements the conclusions were reached that the elastic range of the units tested was equal to, or, in some cases, in excess of, the maximum working range set by the usual deflection requirements (deflection less than 1/360 span) on a 10-ft. span, this elastic range being the fundamental criterion of the usefulness of the units. The maximum load carried by the test units showed a considerable and satisfactory margin of safety against overloading. The method in common use for designing beams afforded a satisfactory basis for predicting the elastic behaviour of the units, the stiffness of which, calculated from average dimensions, was in close agreement with that calculated from the deflection. The spot welds used in joining the sheets were amply strong in shear, though some might have failed by the separation, through buckling under test, of the two-sheets in the web, between the welds. It was recommended that controlled automatic spot-welding should be employed during manufacture to ensure that the neutral axis should remain in one plane, since irregular connection between the two sheets would render the cross-section of the beam variable along its length.

The application of the Keystone beam steel floor is not easy to illustrate photographically, but the views given in Figs. 2 and 3, on this page, and in Figs. 4 and 5, on page 210, will give some idea of one application. The building is a new ward for a hospital in Washington, D.C. It consists of a main portion, 136 ft. long by 44 ft. wide, with two divergent wings at each end, each wing being 82 ft. long by 38 ft. There is also a detached administration building, con-

nected to the main portion by a corridor. The building, when completed, will consist, for the most part, of three floors, with a total floor area of 68,000 sq. ft., the weight of steel employed being about 360 tons. As originally designed, the building was to have concrete-joist floors carried by exterior brick bearing walls and an internal steel skeleton. The plans were modified, however, to include the cellular steel floor which enabled the structural-steel framework to be made lighter. The alterations reduced the dead load on the foundations from 80 lb. to 45 lb. per square foot, and also made the electrical wiring easier to install.

The floor used was the standard type shown in arrangement (*a*), Fig. 1. The plates are formed in a rolling mill and then passed, after the top and bottom members have been assembled, through a welding machine. In this machine the electrodes are in the form of rollers, which are kept, by pressure, in continuous contact with the plates, automatically spot-welding them together at intervals along the centres shown in Fig. 1. The completed unit was dipped in asphalt, this coating being afterwards baked on. The plates were 0·063 in. thick and weighed about 21 lb. per lineal foot of a width of 2 ft. The sections were of varying lengths, the longest being 17 ft. 6 in., and weighing about 350 lb. Fig. 4 shows the floor in the region of the bifurcation of one pair of wings. From the condition of the framework it will be evident that the building had not reached its full height when the photograph was taken, the brick walls appearing flush with the floor. This condition illustrates an advantage claimed for the floor construction, namely, that no scaffolding is needed. The walls are first raised to the height of the first floor and that floor is laid across with its edges resting on angle wall plates. When this floor has been completely laid, the bricklayers use it as a platform and continue the walls a stage higher to take the second floor, and so on.

The floors have not the full unsupported span of 44 ft. across the main building but are carried, where, necessary, on joists; some joists are visible, for example, in Fig. 5. This is a view of the basement; hence the presence of certain of the sanitary pipes. The ridged formation of the under side of the floor is evident, a similar appearance being visible on the top of the floor in Fig. 4 and also in Figs. 2 and 3. Of these two latter views, Fig. 2 is of a corridor in one of the wings and Fig. 3 is of a bed position in a ward, both views showing some details of the wiring system referred to earlier. The three lines down the corridor in Fig. 2 show the run of the feeders for three distinct services. That on the right is for 110-volt current, the outside line on the left is for "Nurses' Call" wiring, and the one immediately to the right of it carries the leads for telephones and radio receivers. It will be clear that the lines run at right angles to the direction of the cells in the floor, so that the wires can be "fished" right along the corridor, and that one in each group of three cells can form a side run for one of the feeders, the sequence being repeated along the line. The circular fittings are access boxes at the points where the feeders take a right-angle turn along the cells into the wards on either side. Normally, such a number of access boxes is not necessary, but in this particular instance a high degree of flexibility for the point of take-off was required. The access boxes are carried to the level of the top of the filling, above the floor, which, in this case, is of concrete covered with rubber tiles. The wiring can be done when the floor is finished, but before the rubber tiling is laid down. The view in Fig. 3 shows the other end of the leads for the three services, where the cells run parallel to the walls. A suitable fitting is attached to each cell and the wire is led through conduits to the respective points. The floor in the wards is filled with concrete with terrazzo above.

The Keystone beam construction may be finished in a variety of ways. Arrangements (*a*), (*c*) and (*e*) in Fig. 1 require some sort of filling before a top covering can be applied. With arrangements (*b*) and (*d*), the level floor makes covering a simpler matter. As regards the underside of the floor, in some cases beams may be left uncovered, except for paint or other decoration, the appearance then presented resembling a ceiling of closely-pitched beams. In most instances, however, a flat ceiling is desired. With arrangements (*b*) and (*d*), this can be obtained by simply inverting the floor and filling in the top, but with the other arrangements a flat ceiling is secured by suspended wire-lath and plaster, pre-cast concrete slabs, etc. This method is employed where there are overhead pipes which it is desirable to conceal. When small openings are to be cut in the floor for pipes, etc., this is readily done by the oxy-acetylene blow-pipe. Larger openings, of course, need support round them, as in the pipe-shaft opening seen to the left of Fig. 5, where the shaft runs through all the floors. It may be mentioned, in conclusion, that the H. H. Robertson Company have an English branch at Mersey Iron Works, Ellesmere Port, Wirral, Cheshire, and a London office at Clutha House, Princes-street, S.W.1.

INSTITUTION ELECTIONS.

INSTITUTION OF STRUCTURAL ENGINEERS.

Associate Member to Member.—Arthur Edmund Cotton, North Harrow, Middlesex; William Albert Fairhurst, Newton Mearns, Glasgow; Roland William Knowles, Alsager, Stoke-on-Trent; Jack Vickerman Oldfield, A.M.Inst.C.E., Grimsby.

INSTITUTION OF CIVIL ENGINEERS.

Associate Member to Member.—Cyril Oliver Boyse, B.Sc.(Eng.) (*Lond.*), London, S.W.7; Ronald James Cornish, M.Sc. (*Manch.*), Manchester; Eric Louis Kelting, Bridgwater, Somerset; Thomas Angus Lyell Paton, B.Sc. (Eng.) (*Lond.*), London, S.W.1.

Associate Member.—Jules Stephen Brabants, B.E. (*National*), Rogiet, near Chepstow, Mon.; Andrew Alexander Scott Brodie, B.Sc. (*Edin.*), Glasgow; Thomas Soulsby Charlton, B.Sc. (*Leeds*), Rotherham; William Murray Cormie, B.Sc. (*Glas.*), Dumbarton; George Francis Dorrell, Kampala, Uganda; Ernest William Hampshire, B.Sc. (Eng.) (*Lond.*), London, W.12; Wilfred Howard Heydon, B.Sc. (Eng.) (*Lond.*), Caldecott, near Market Harborough; Walter Thomas Hopkins, B.Sc. (*Wales*), Corsham, Wilts.; Peter Mason, B.Sc. (Eng.) (*Lond.*), Shaftesbury, Dorset; Frank Bentley Mayo, B.Sc. Tech. (*Manch.*), Thornaby-on-Tees; John Maurice Moore, Annan, Dumfriesshire; William Alexander Murray, B.Sc. (*Cape Town*), Upington, S. Africa; Stanley Felipe Owen, Kuala Lumpur, F.M.S.; Donald Graham Pirrie, Leamington Spa; Horace Edgar Rose, B.Sc. (Eng.) (*Lond.*), Manchester; Kasi Govinda Sarma, B.Eng. (*Mysore*), B.Sc. (*Vict.*), Bombay; Felix Dagworthy Taylor, Hayes, Middx.; Henaleigh Barrett Walter, Port Elizabeth, S. Africa.

BOOKS RECEIVED.

The Ohio State University. The Engineering Experiment Station. Circular No. 38. *America's Sources of Power and National Defense.* By C. E. MACQUIGG. Columbus, Ohio, U.S.A.: The Engineering Experiment Station, The Ohio State University.

Mastering Momentum. A Discussion of Modern Transport Trends and Their Influence Upon the Equipment of American Railways. By DR. L. K. SILLCOX. New York: Simmons-Broadman Publishing Corporation.

United States Bureau of Mines. Bulletin 429. *Fire-Retardant Treatments of Liquid-Oxygen Explosives.* By A. R. T. DENUES. Washington: Superintendent of Documents. [Price 20 cents.]

Annual Report of the Chief Inspector of Factories for the Year 1939. London: H.M. Stationery Office. [Price 1s. net.]

Electric Power Stations. Volume I. By T. H. CARR. London: Chapman and Hall, Limited. [Price 30s. net.]

Intermediate Electricity. By R. W. HUTCHINSON. London: University Tutorial Press Limited. [Price 12s. 6d.]

United States Bureau of Mines. Minerals Yearbook, 1940. (*Review of* 1939.) Washington: Superintendent of Documents. [Price 2 dols.]

The Mining Year Book for 1941. Compiled by WALTER E. SKINNER. London: Walter E. Skinner, 15, Dowgate-hill, E.C.4; "Financial Times," 72, Coleman-street, E.C.2. [Price 20s. net.]

Chamber of Shipping of the United Kingdom. Annual Report for 1940-41. London: Offices of the Chamber, Bury-court, St. Mary Axe, E.C.3.

Ministry of Labour and National Service. Factory and Welfare Department. Factory Form 1892. *Memorandum Issued by the Ministry of Labour and National Service in Connection with the Building Operations and Works of Engineering Construction (Welfare and Safety Provisions) Order,* 1941. London: H.M. Stationery Office. [Price 2d. net.]

The British Electrical and Allied Industries Research Association. Technical Report. Reference W/T4. *Improvement of Load Factor in Farm Grinding.* By W. H. CASHMORE and C. A. C. BROWN. London: Offices of the Association, 15, Savoy-street, W.C.2. [Price 2s. 6d. net.]

United States National Bureau of Standards. Building Materials and Structures. Report BMS. 62. *Structural Properties of a Precast Joist Concrete Floor Construction, Sponsored by the Portland Cement Association.* By H. L. WHITTEMORE, A. H. STANG and D. E. PARSONS. Washington; Superintendent of Documents. [Price 10 cents.]

Works Organization and Management. By E. J. LARKIN. London: Sir Isaac Pitman and Sons, Limited. [Price 35s. net.]

The Technology of Magnesium and Its Alloys. A Translation from the German, by the Technical Staffs of F. A. Hughes and Company, Limited, and Magnesium Elektron, Limited, of "Magnesium und seine Legierungen." Compiled by DR.-ING. E. h. ADOLF BECK. Lumn's-lane, Clifton Junction, Swinton, near Manchester: F. A. Hughes and Company, Ltd. [Price 30s.]

PERSONAL.

MR. A. S. QUARTERMAINE, M.C., B.Sc., M.Inst.C.E., whose services were loaned temporarily, last June, to the Ministry of Aircraft Production, and who was appointed Director-General of Aircraft Production Factories, has now resumed his duties as Chief Engineer of the Great Western Railway.

MR. H. J. PEACOCK, divisional superintendent, Traffic Department, Great Western Railway, Cardiff, has been appointed assistant superintendent of the line. MR. H. H. PHILLIPS, assistant divisional superintendent, Cardiff, has been appointed to succeed Mr. Peacock as divisional superintendent, Cardiff.

MR. JOHN CROSSLAND has been made acting Head of the Department of Mining, University of Leeds, in succession to PROFESSOR F. S. ATKINSON, who resigned recently.

MR. R. J. DURLEY, M.E.I.C., Secretary Emeritus of the Engineering Institute of Canada, has been elected a member of the Council of the Institution of Civil Engineers and is Chairman of the Canadian Advisory Committee of the Institution.

MR. GILBERT S. SELUMPER, C.B.E., Railway Control Officer in the Ministry of Transport, has been appointed a member of the Railway Executive Committee.

PROFESSOR J. C. PHILIP, O.B.E., F.R.S., President of the Society of Chemical Industry, who has been appointed the next President of the Chemical Society, is to receive the Honorary Degree of LL.D., from the University of Aberdeen, of which he was formerly a student.

The Governors of the Constantine Technical College, Middlesbrough, have appointed MR. STANLEY BARNETT lecturer in electrical engineering. He is succeeding MR. JOHN PILLING, who has been made Head of the Electrical Engineering Department, Chesterfield Technical College.

MR. W. J. DAWSON, a director of Messrs. Hadfields, Limited, and chairman of the Steel Castings Research Committee, which is a joint research committee of the Iron and Steel Institute and the British Iron and Steel Federation, has been awarded the E. J. FOX Medal of the Institute of British Foundrymen.

MESSRS. RADIATION LIMITED, 7, Stratford-place, London, W.1, inform us that the London offices and showrooms of the Radiation Companies listed below are now centralised at 7, Stratford-place:—Messrs. Arden Hill and Company, Limited; Davis Gas Stove Company, Limited; Eagle Range and Grate Company, Limited; Fletcher Russell and Company, Limited; Wilsons and Mathiesons, Limited; and John Wright and Company, Limited.

MR. H. E. HARRIS, who is a director of Messrs. Platt Brothers, and Company, Limited, Hartford Works, Oldham; and of Messrs. Asa Lees and Company, Limited, Soho Works, Oldham, has now joined the board of directors of Messrs. J. Hibbert and Company, Limited, Darwen, Lancashire.

MR. N. R. REES, who has for some years acted as technical adviser to the foundries department of Messrs. The Staveley Coal and Iron Company, Limited, near Chesterfield, has been appointed foundries general manager in succession to the late MR. J. B. ALLAN.

MR. FRANK PARKINSON, chairman of Messrs. Crompton Parkinson, Limited; Derby Cables, Limited; and The British Electric Transformer Company, Limited, has been granted leave of absence from his executive positions in these companies to enable him to place his whole time at the disposal of the Ministry of Supply, on his appointment as Deputy Director-General of Contracts. He will, however, retain his seat on the board of the above-mentioned companies.

TENDERS.

WE have received from the Department of Overseas Trade, Millbank, London, S.W.1, particulars of the undermentioned tenders, the closing dates of which are as stated. Details may be obtained at the above address, quoting the reference numbers given.

Transformers.—With reference to the call for tenders for one 150-kVA, one 200-kVA, and one 250-kVA, 6,600/380/220-volt, three-phase, 50-cycle, indoor-type, oil-immersed, self-cooled transformers with high-tension and low-tension switchgear, for the Mental Hospital, Krugersdorp, noted on page 88, *ante*, we now learn that the Union Tender and Supplies Board, Pretoria, has postponed the closing date from March 13 until April 10. (T. 15,287/41.)

Switchgear.—We also announced, on page 88, *ante*, that the City Council of Pretoria had called for tenders for extra high-tension switchgear for use in connection with a proposed mains extension. In this case the closing date has been postponed from March 17 until March 31. (T. 15,273/41.)

NOTES FROM SOUTH YORKSHIRE.

SHEFFIELD, Wednesday.

Iron and Steel.—The Government's decision to curtail non-essential work will not seriously affect Sheffield. The engineering and tool trades will naturally be undisturbed, and the cutlery trade will not be affected seriously. While trade inquiries from abroad are not as numerous as they were three or four months ago, a steady volume of export business is being carried on. Sheffield Chamber of Commerce has received several inquiries for light products from Canada, while merchants in Palestine, Greece, Australia, Argentina, Canada, Chile, and New Zealand wish to set up agencies for Sheffield products. Business in raw and semi-finished materials has been well maintained. Outputs continue to expand, and when more melting plant is available new records will be set up. Both basic and acid materials are in strong request. Cold-rolled and hot-rolled strip are in active demand for a variety of purposes. Re-rollers are busy, and have an accumulation of orders. Rolling mills, foundries, and forges are operating at full capacity. Makers of railway rolling-stock equipment report a steady improvement in the demand during the past month. Forged-steel weldless buffers are in request on both home and overseas account; Egypt and India are particularly good customers. Laminated springs are a progressive line, and wheels, axles, and tyres are being turned out in larger quantities. Drop forgings and stampings, and hollow forgings and pressings are on order for a wide range of uses. The special-steel branches are actively employed, and every effort is being made to increase outputs. Stainless and rustless steels are in strong demand, and the call for heat- and acid-resisting materials is exceptionally heavy. High-efficiency steels for the manufacture of twist drills, milling cutters, reamers and machine tools are in brisk demand.

South Yorkshire Coal Trade.—Business in most types of fuel has increased during the past fortnight. Larger quantities are moving from colliery sidings and merchant depots, and industrial concerns continue to consume large tonnages. Steams are in strong demand, and smalls and slacks are also being purchased for electric power stations. The house coal market is buoyant, and the coke market steady. Most types of coke are in strong demand.

NOTES FROM THE NORTH.

GLASGOW, Wednesday.

Scottish Steel Trade.—There has again been little change in the state of the steel trade of Scotland. The requirements of the Government have been of a varied character and the demand has covered all kinds of steel, with the result that the steel works have all been fully employed. The raw material position is satisfactory. Consumers of boiler plates, ship plates and sections are all specifying freely and their demands are of a pressing nature. Lighter material has been in great demand, and the order books of makers of steel sheets are well filled for some months ahead. The following are to-day's quotations:—Boiler plates, 17*l.* 12*s.* 6*d.* per ton; ship plates, 16*l.* 3*s.* per ton; sections, 15*l.* 8*s.* per ton; medium plates, ¼ in. and thicker, rolled in sheet mills, 21*l.* 15*s.* per ton; black-steel sheets, No. 24 gauge, 22*l.* 15*s.* per ton; and galvanised corrugated sheets, No. 24 gauge, 26*l.* 2*s.* 6*d.* per ton, all for home delivery.

Malleable-Iron Trade.—The demand for bar iron continues and the West of Scotland malleable-iron makers are all fully employed. The tonnage now on order is such that the plant will be kept running at full capacity for some time, and the forward inquiry is also satisfactory. Re-rollers of steel bars are busy, but owing to the good supply of semies and the large output obtained, many of the most urgent orders have been completed; in some cases orders can now be accepted for early delivery. The current market quotations are as follows:—Crown bars, 15*l.* 12*s.* 6*d.* per ton; No. 3 bars, 13*l.* 12*s.* 6*d.* per ton; No. 4 bars, 13*l.* 17*s.* 6*d.* per ton; and re-rolled steel bars, 17*l.* 15*s.* per ton, all for home delivery.

Scottish Pig-Iron Trade.—Conditions in the Scottish pig-iron trade have not altered during the week, and a steady and substantial output is being obtained from the furnaces in blast. The demands from consumers, however, are pressing, and the total production of hematite and basic iron is quickly taken up. Foundry iron is moving more freely and there are indications that an early increase in the demand is probable. Stocks of raw material are satisfactory. The following are to-day's quotations:—Hematite, 6*l.* 18*s.* 6*d.* per ton, and basic iron, 6*l.* 0*s.* 6*d.* per ton, both delivered at the steel works; foundry iron, No. 1, 6*l.* 5*s.* 6*d.*, and No. 3, 6*l.* 3*s.* per ton, both on trucks at makers' yards.

ASBESTOS PRODUCTION IN QUEBEC.—The Bureau of Mines of Quebec informs us that 345,581 tons of asbestos were produced in that Province during 1940, compared with 364,454 tons in 1939.

NOTES FROM CLEVELAND AND THE NORTHERN COUNTIES.

MIDDLESBROUGH, Wednesday.

General Situation.—The greater part of the heavy iron and steel production as well as of the large and increasing imports from the United States, is still passing promptly into use for purposes associated with the war effort, leaving little material available for ordinary industrial undertakings. Supplies of iron and steel, however, are reaching licensed consumers in adequate quantities.

Cleveland Iron Trade.—There is no lack of iron produced from native ores. Cleveland pig is still in only very limited supply and there appears to be no likelihood of an early enlargement of the output. Consumers in this area, however, are able to obtain supplies from other producing centres. Merchants are handling slightly increased parcels of iron but could readily dispose of larger quantities. Cleveland pig production is still confined to the occasional temporary change-over of a basic furnace to the production of foundry iron. The fixed price remains on the basis of No. 3 quality at 128*s.*, delivered within the Tees-side zone and is stated to be unremunerative.

Basic Iron.—There is still no saleable basic iron, the nominal figure for which remains at 120*s.* 6*d.* The make, however, is ample for the heavy requirements of the producers' steel-making plants.

Hematite.—Some uneasiness has been felt regarding the statistical state of the hematite branch of trade, but the outlook appears to be improving. Distributable parcels are allocated with great care to ensure that the iron available shall reach those quarters in which it is most needed. It is hoped that conditions in the near future will permit some enlargement of the output and a considerable increase in supplies from overseas is confidently anticipated. The official quotations are ruled by No. 1 grade of iron at 138*s.* 6*d.*, delivered to North of England areas.

Foreign Ore.—There has been some shortage of hematite ores but new sources of supply are being tapped and should effect an early improvement in the position. Cargoes of other ores from abroad are arriving regularly and the increasing use of native ironstone continues to reduce the dependence on deliveries of foreign raw material.

Blast-Furnace Coke.—Sellers of Durham blast-furnace coke have command of a large tonnage, but their commitments are extensive and they are not desirous of accepting new orders. Local users are covered well ahead. The fixed prices are based on good medium qualities at 35*s.* 6*d.*, *f.o.r.*

Manufactured Iron and Steel.—The plentiful supply of semi-finished iron and steel enables the re-rolling mills to operate at their maximum capacity. The finished industries, with the exception of the heavy joist production branch, are very actively engaged. Manufacturers are fully sold over the allocation of supply periods and can accept orders only for deferred delivery. The demand for bars, sheets, plates and light sections is particularly heavy. Special alloy steels are being specified in increasing quantities and railway material is also in strong request. Soft-steel billets are quoted at 12*l.* 5*s.* per ton; hard billets at 13*l.* 12*s.* 6*d.* per ton; joists and sections at 15*l.* 8*s.* per ton; heavy plates at 16*l.* 3*s.* per ton; and heavy rails at 14*l.* 10*s.* 6*d.* per ton.

Scrap.—The scrap market is active, and buyers are anxious to negotiate for extensive supplies, particularly of the heavy grades. The demand is greatest for heavy steel scrap.

STEEL HELMETS FOR FIRE-PREVENTION PERSONNEL.—Arrangements for the purchase, by employers, of supplies of the new civilian-type steel helmets for the equipment of fire-prevention personnel on business premises have been made by the Ministry of Home Security. Local authorities will act as agents for the Ministry, and sales will be made through distributing depots set up by these authorities in most of the large towns in Great Britain. In order to obtain helmets, occupiers of business premises must first obtain from their local authority a form (C.H./18), on which they will enter the number of helmets required, showing the various sizes and the town from which they could most conveniently collect the helmets. The forms will be despatched by the local authorities, after scrutiny, to the Minister of Home Security, and as helmets become available, the Ministry will send to each applicant a permit to buy the required number. The price is 5*s.* 6*d.* each. Priority of supplies will be given to areas to which the Fire-Prevention (Business Premises) Order has been applied by the Regional Commissioners. Later, supplies will be available for fire-prevention personnel in other areas, and the distribution scheme will be completed with the provision of steel helmets for all industrial and commercial workers, as originally contemplated.

NOTICES OF MEETINGS.

IT is requested that particulars for insertion in this column shall reach the Editor not later than Tuesday morning in the week preceding the date of the meeting.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—To-night, 6 p.m., The Mining Institute, Newcastle-upon-Tyne, 1. "Some General Observations on Vibration," by Mr. J. Calderwood.

INSTITUTION OF ELECTRICAL ENGINEERS.—*North Midland Students' Section:* Saturday, March 15, 2.30 p.m., The Hotel Metropole, King-street, Leeds. Ordinary Meeting. Film Programme. *North-Western Centre:* Saturday, March 22, 2.30 p.m., The Engineers' Club, Albert-square, Manchester. Joint Meeting with THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS. "Some Aspects of Line Construction," by Mr. R. M. Chamney.

SHEFFIELD METALLURGICAL ASSOCIATION.—Saturday, March 15, 3 p.m., Sheffield Metallurgical Club, 198, West-street, Sheffield, 1. Joint Meeting with THE INSTITUTE OF CHEMISTRY. "Modern Methods of Metallurgical Analysis," by Mr. E. J. Vaughan.

INSTITUTION OF CIVIL ENGINEERS.—*South Wales and Monmouthshire Association:* Saturday, March 15, 3.15 p.m., The Engineers' Institute, Park-place, Cardiff. "Engineering Aspects of the Channel Tunnel," by Mr. Rolt Hammond. *Institution:* Tuesday, March 18, 1.30 p.m., Great George-street, Westminster, S.W.1. Ordinary Meeting. (i) "Aesthetics of Engineering Structures," by Dr. Oscar Faber. (ii) "The Design of Floor Mills, Granaries, Warehouses and Silos," by Dr. Oscar Faber.

INSTITUTION OF MINING AND METALLURGY.—Thursday, March 20, 3.30 p.m., The Geological Society's Rooms, Burlington House, Piccadilly, W.1. Ordinary General Meeting. (i) "Assay Office Equipment at the Nundydroog Gold Mine, South India." by Mr. M. J. Williams. (ii) "The Flotation of Pyrite and Arsenopyrite in Tin Ore Concentrates," by Mr. F. B. Michell.

INSTITUTION OF MECHANICAL ENGINEERS.—Friday, March 21, 2.30 p.m., Storey's-gate, St. James's Park, S.W.1. General Meeting. Informal Discussion on "Munitions Labour Supply Organisation."

JUNIOR INSTITUTION OF ENGINEERS.—Saturday, March 22, 2 p.m., 39, Victoria-street, Westminster, S.W.1. Ordinary Meeting. "The Chemist, the Chemical Engineer and the Mechanical Engineer," by Mr. P. A. Cartwright.

NOTES FROM THE SOUTH-WEST.

CARDIFF, Wednesday.

The Welsh Coal Trade.—As it was feared that there might be a shortage of labour at the South Wales mines as a result of the recruitment of miners for the Forces, and of the transference of unemployed men to other work, a special meeting of the Conciliation Board Sub-committee was called, and Mr. D. R. Grenfell, Secretary for Mines, attended. According to the official report issued after the meeting, Mr. Grenfell asked that there should be sent to him a considered opinion regarding the future productive capacity of the coalfield and of the minimum man-power that should be reserved for it. It was added that both the owners' and men's representatives were of the opinion that no workman should be withdrawn or allowed to leave the industry at present. Home demand was still brisk and provided the outstanding feature of the market. Industrial users showed considerable interest in the high-volatile bituminous grades, which, however, were very difficult to stem for some time ahead owing to recent heavy sales. Dry steams were busy owing to increased demands from Eire, but foreign business was on a small scale. Best large grades were well provided with outlets, and the sized sorts were scarce and strong. Bituminous smalls were only very sparingly available for a long time ahead, but dry smalls were plentiful. Cokes were busy but patent fuel was slow.

The Iron and Steel Trade.—Activities were well sustained in the South Wales iron and steel and allied trades last week. The demand was well sustained and was not easily satisfied owing to the fact that order books generally were well filled.

AMERICAN EXPORTS OF IRON AND STEEL SCRAP.—Exports of iron and steel scrap from the United States in November, 1940, the first complete month in which overseas shipments were subject to licensing, totalled only 74,349 gross tons, as compared with 258,926 tons in October and 272,656 tons in November, 1939. In the first 11 months of last year, 2,753,108 tons of scrap were sent overseas, against 3,371,025 tons in the corresponding period of 1939

CELLULAR SHEET-STEEL FLOORING.

MESSRS. H. H. ROBERTSON COMPANY, PITTSBURGH, PA., U.S.A.

(*For Description, see page* 207.)

FIG. 4. FLOOR BEING ERECTED.

OPTICAL PROTRACTOR AND BRINELL MICROSCOPE.

THE use of the sine bar, now often employed in both the toolroom and in production as a means for determining angles in finished work or of setting work to a desired angle, involves, as is well-known, either some calculation or reference to a table constructed in accordance with the length of the bar in use. To eliminate calculation or reference, Messrs. Bausch and Lomb have introduced an optical protractor, by means of which, it is claimed, unskilled operators can quickly learn to make readings and settings to a degree of accuracy comparable with those obtained by a 5-in. sine bar in the hands of a skilled operator, by direct reading from a scale on the instrument. The Bausch and Lomb optical protractor is distributed in this country by Messrs. A. C. Wickman, Limited, Coventry. The instrument consists of a bar-like base of hardened and ground steel. A Vee-slot running longitudinally down the centre of the underside of the base enables the protractor to be used on work of circular cross-section, as well as on flat surfaces. To this base is hinged the body of the protractor, in which body is mounted an annular rotatable part carrying in its opening a spirit level, and on its periphery a graduated scale. The scale is provided with a vernier, which enables readings of one minute of arc to be made, and both it and the spirit level are viewed through an eye-piece.

The body is hinged on the base and is provided with an adjusting screw for correction before use. To check the angle of a finished piece of work, the central ring is either rotated by hand or by means of a micrometer screw, which gives fine adjustment, until the required angle appears on the scale. The protractor is then applied to the work, which is moved until the bubble in the spirit level becomes central. This rapid and simple operation determines whether the required inclination of the work concerned has or has not been attained. A similar procedure is followed when setting out work to be finished to a desired angle on jigs or machine-tool tables. Other examples of the uses of the protractor are the determination of the inclinations of tapered turned parts, dovetails, and so forth. The compactness and light weight of the instrument make it possible to employ it in circumstances in which it might be awkward, if not impossible, to use a sine bar.

Another recent production of Messrs. Bausch and Lomb, also distributed by Messrs. A. C. Wickman, Limited, is an improved form of Brinell microscope, that is, a microscope for measuring the diameter of the impression made by the ball of the Brinell hardness-testing machine, on the accuracy of which reading the hardness measurement depends. The microscope is made in three types which differ only, however, in the method of illumination. The instrument as arranged for daylight illumination is a plain tube, the base of which rests directly on the work. A flat annular mirror receives the light from an opening in the side of the tube and reflects it on to the specimen, an arrangement which, it is claimed, is a distinct improvement on methods hitherto adopted, the contour of the impression standing out very clearly and in strong contrast. The impression is, of course, viewed through the opening in the centre of the mirror and the optical elements are adjusted so that it is always in focus. The magnification is 20 diameters. The field covered is approximately 8·2 mm., and the scale in the eyepiece is calibrated to read the diameter of the Brinell impression in tenths of a millimetre. The eyepiece is set at the makers' works, the draw-tube being held in position by a clamping ring and the lens assembly being held by a spacer ring and a setscrew in the draw tube.

In the other two types of microscope the main tube is provided with a right-angled branch in place of the opening in the daylight instrument. This branch carries, in the one case, a dry battery and a 1·1-volt bulb, and, in the other, a transformer with cable attachment and a 2·33-volt bulb, the transformer primary being wound for 220 volts. These types enable the reading to be made by artificial light. The lower part of the bases of all three types are made of cold-rolled steel to withstand hard wear, and the body is finished with chromium plating and the now general black crackle protective coat.

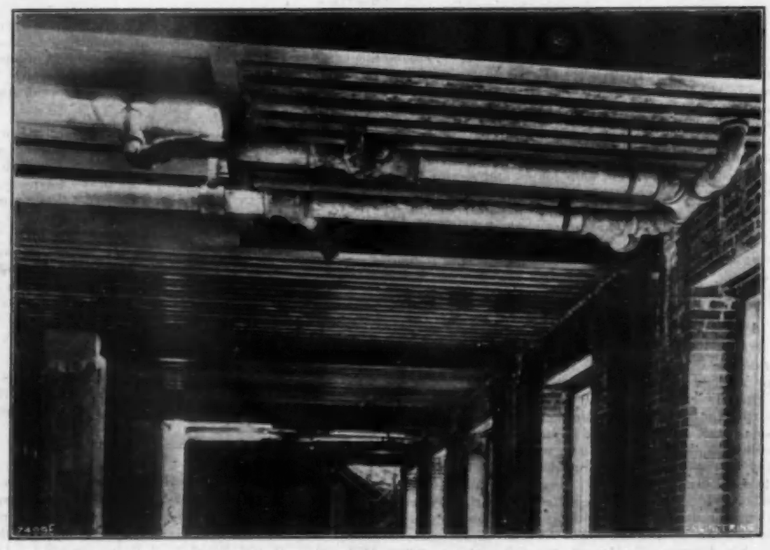


FIG. 5. UNDERSIDE OF FLOOR.

THE PICKWICK LANDING DAM

(For Descrip page.

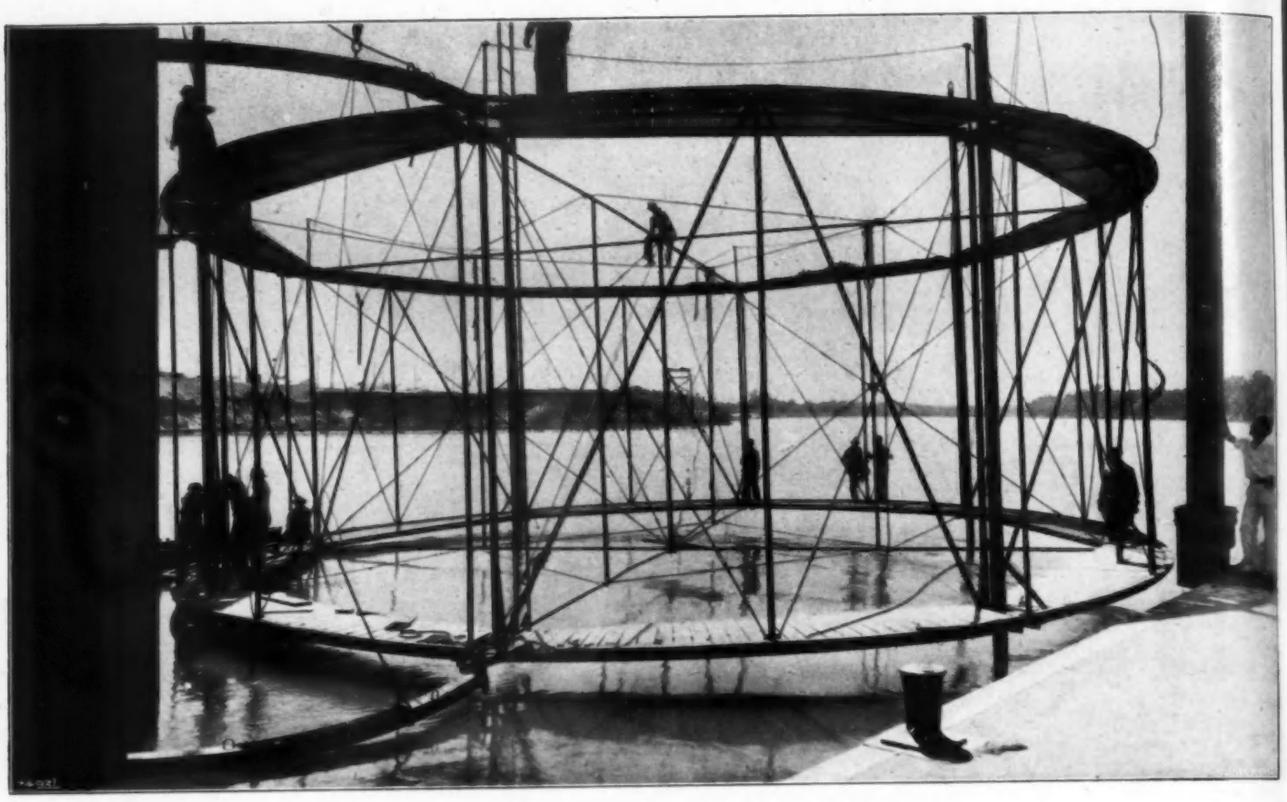


Fig. 64. Template for Cellular Sheet-Pile Cofferdam.

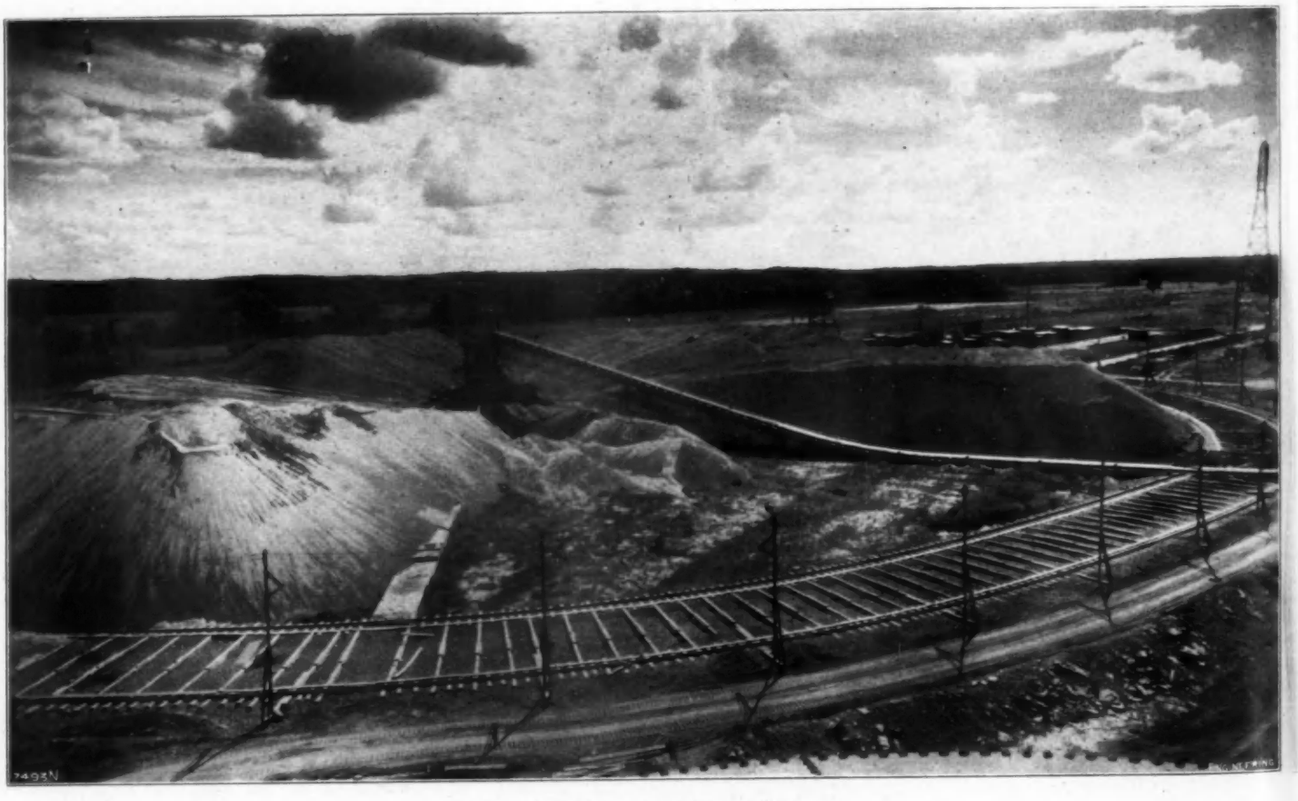


Fig. 66. Kern Tower and Feeding Conveyor.

DAM ON THE TENNESSEE RIVER, U.S.A.

(For Description, see page 201.)

FIG. 65. UNLOADING QUAY FOR CONCRETE AGGREGATE.

FIG. 67. CONCRETE-MIXING TOWER AND FEEDING CONVEYOR.

UNIV. OF MICH.

ENGINEERING.

Offices for Publication and Advertisements, 35 & 36, Bedford Street, Strand, London, W.C.2.

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One Two-Page Plate.—THE PICKWICK LANDING DAM ON THE TENNESSEE RIVER, U.S.A.

ENGINEERING

FRIDAY, MARCH 14, 1941.

VOL. 151. No. 3922.

THE GUARANTEED WEEK.

THERE is no difference of opinion in any responsible quarter regarding what must be the mainspring of all our actions at the present time. The business of the moment is to win the war, as quickly as possible. That consideration, which overrides all others, has, naturally, led to the introduction and imposition of many practices and controls that would be opposed, or viewed with mistrust in times of peace. There is no important opposition by any party to these restraints on normal life. They are suffered, and, indeed, welcomed, as necessary weapons in the military and economic conflict in which we are engaged. Even this war, however, is but a stage in the history of the country and the Empire. It will pass in a period which will be brief compared with the long years necessary for permanent advance in the social structure of our commonwealth, and it would not be good generalship entirely to lose sight of the possible ultimate reactions to activities now imposed by over-riding circumstance. That this is recognised by the Government is made evident by the detailing of certain Ministers to plan the post-war age to which the present conflict will lead.

An example of how the best intentions may overstep the limits of the ultimately useful has been furnished by the 100-per cent. excess profits duty. The original idea that no one should be allowed to make a profit out of the war was unexceptionable, but it begins to appear in practice that this particular method of attaining that end is likely to have reactions nullifying any immediate benefit. The remodelling and extensive enlargement of manufacturing plants imposed by the munitions programme will find, at the end of the war, many engineering firms able to resume their normal activities only after important reconstruction, involving heavy capital expenditure. The pursuit of a financial policy which renders impossible the building-up of an adequate reserve to meet these conditions is likely to bring about a period of uncertainty and industrial confusion, of which one of the important reactions will be widespread unemployment. This danger has been pointed out by various manufacturers, and groups of manufacturers, who are quite prepared to agree that any funds made available by a reduction of the 100-per cent. tax shall be so controlled that they will be available only for the extensive remodelling which will ultimately be imperative. Although no modification of this tax has been promised, there are signs that the Chancellor of the Exchequer has been impressed by the cogency of the views presented to him.

A relaxation of the present excess profits duty to the extent necessary to enable manufacturers properly to prepare for the exceptional conditions which will follow the war, although it would not balance, would to some extent offset the undertaking which has been entered into with labour organisations. Many times the promise has been repeated that labour customs and practices, set aside owing to the exigencies of war, shall be fully restored at its conclusion. The fact that no similar promise has been made to manufacturers or employers' organisations is, in one way, perhaps just as well. The development of the social structure of this country, carrying with it improvement in the status of the workpeople, has been gradually progressing over at least the last hundred years, and a cataclysm such as the present cannot pass without further modification. That the waste of the war will leave grave difficulties there can be no question, but experience of the past makes it fairly certain that, in due course, our social organisation will be found to have made further progress. If, however, that progress is not to be gravely hindered, the relative positions of capital and labour must not be too drastically altered. Labour is promised that it shall start on an unknown future date from the position it occupied in September, 1939; capital is to start from a position as yet undefined. If the status of capital is seriously weakened, it will not be able properly to sustain its side of the partnership on which prosperity depends, and the bright prospects which are being held before labour will prove a mirage.

We have said that it was just as well that no promise of reversion to pre-war conditions had been made to manufacturers. Our object was to accentuate the point that, the fewer the promises now made, the fewer the disappointments a problematical future will be likely to bring. It is highly undesirable that attempts to determine the conditions of a post-war world should be made at the present time. The fact that labour has been told it is to regain all the ground it had won up to the beginning of the war is no guarantee that it will not also expect to occupy still further territory. If it does, the position of capital must also be modified. It cannot be said too often that only in fair partnership can labour and capital together hope to achieve prosperity.

Mr. Bevin has just called for 50,000 extra workers for shipbuilding and ship-repairing. They are to have a guaranteed week. A guaranteed week, however, formed no part of the conditions of employment in the shipyards in September, 1939, and if after the war the position at that date is to be restored, then this new stage in labour's charter will disappear as suddenly as it has arisen. No great knowledge of the history of organised labour in this country is necessary to the realisation of the fact that this is not likely to happen. As Mr. Bevin hopes to draw men from other occupations for his new shipyard drive, and as many of these are probably now in regular work, it is, no doubt, desirable, and even necessary, that a definite promise of continuity of employment should be made to them. None the less, this procedure has introduced a new factor into the labour problem of the shipyards, and is but further evidence that neither labour nor capital will or can ever again find itself in exactly its old position.

Although the principle of the guaranteed week has been in operation in some industries for a considerable time, it would be short-sighted to assume that it may be profitably extended to all, and especially would it be unwise to lose sight of its possible ramifications. Previously to the undertaking now given to shipyard employees, and which obviously cannot be restricted to the new 50,000 hands, the most important extension of the

guaranteed week, during the war, has been to dockers. There is no difficulty in understanding the considerations which have led to this. Under conditions which ruled for many years, dock workers, attached to a particular wharf, or shipping line, maintained but a precarious existence. Their work was casual in the extreme; at times almost more than they could deal with, but at others, entirely lacking. This state of affairs, however, was dealt with some years ago at various ports—notably on the Mersey. A labour pool was set up from which men could be drafted to any work available in the area. This did not constitute a guaranteed week; it did, however, do much to reduce the casual nature of the employment by spreading the available work more fairly. The procedure has now been extended, and men in the pool have a guaranteed weekly wage. Although this may appear an ideal arrangement from the point of view of the men, similar procedure has not, so far, been accepted on the Clyde, the dockers contending that the system of casual labour is so efficient that, during the war, the time of turn-round has been reduced by 33 per cent. This hitch in the North shows that the guaranteed week may be considered from more than one point of view, even by organised labour.

Although shipyard labour was never so casual as dock labour, none the less the advent of severe weather and other uncontrollable conditions prevented complete continuity of employment for many employees. There is no reason to suppose that external conditions will not continue, at times, to interrupt work in shipyards, but for the future, the employees affected will be assured of continuity in their wages. Some, presumably, will be drafted to other work or set to odd jobs, but in case of a serious interruption it would appear that a proportion will have to be paid to stay at home. Under the present unparalleled pressure on the industry, and the financial conditions now ruling, this procedure may not be of radical importance to shipbuilding firms, but it might well constitute a vital matter under the conditions of keen competition, foreign as well as home, which will be experienced after the war. The engineering trades also cannot overlook the possibility that other grades of employees may suggest, and insist, that the guaranteed week must, in fairness, be extended to them.

That Mr. Bevin has been solely influenced by his desire to do anything and everything that will tend to increase production, is made abundantly clear by the fact that he has accompanied his introduction of the guaranteed week by a still more revolutionary ruling. Repudiating any suggestion of breaking up crafts, of which no one would be likely to suspect him, Mr. Bevin none the less proposes that men should not be limited to any particular type of work. All crafts should work as a team and a ship should not be delayed because a particular man is not available to finish a particular job. How far it will prove possible to carry out this ruling in practice it would be difficult to say, but if the practice it specifies could be continued in a post-war age it would do much to offset the difficulties of the guaranteed week from the shipbuilding firms' point of view. As, however, it upsets the whole of the rules of the craft unions, which they have worked for years to establish, it is practically certain that efforts will be made to abolish it when hostilities cease. It may be, however, that experience under present conditions will teach the unions that profound modifications in their pre-war practice will be of benefit both to them and their members, and that no pedantic insistance on a re-establishment of the old position will be insisted on.

Even such a casual examination of the implications of the guaranteed week as that which we have given illustrates the gravity of the problems which it may ultimately raise. This is not a reason for rejecting it; in its intensification of the war effort it must be welcomed. Our examination does suggest, however, that it would be wise that promises for the restoration of pre-war practices should not be restricted to one side in a partnership. If that side is put in the position to veto all innovations made during the war which cut across those practices and to welcome and foster any which are to its advantage, then the working of the partnership is likely to be strained.

CONCENTRATING PRODUCTION.

THE Government's suggestion to concentrate the production of certain industries in a reduced number of factories working on full time would have delighted the protagonists of rationalisation, of whom so much used to be heard a year or two ago. The very word rationalisation is what R. L. Stevenson called a boss word. There is also something comforting in the idea that all manufacturing effort is most efficiently carried out in large works. Nevertheless, no great reform is wholly good in its context—any more than it is wholly bad. The point to be determined, therefore, is whether on the balance the good will outweigh the bad; in other words, whether, necessary as such a scheme may be in war time, it may not ultimately lead to the permanent weakening of our industrial structure. Fortunately, we can examine this question with some detachment, since engineering is at present hardly affected by Mr. Lyttelton's proposals. What the Government has set out to do is to close about two-thirds of those factories in the country which are now engaged on non-vital production. The Limitation of Supplies Order has already restricted the activities of these factories; and it is now considered that the reduced output can be more economically produced in a smaller number of factories working full time than in a larger number operating at one-third or less load. The factories that remain in production will manufacture not only for themselves, but for their suppressed competitors; and the labour thus released will become available either for military service of for staffing new war factories. The buildings themselves, it is announced, will become available for storage and other purposes.

At present x factories, employing y men, succeed in producing z articles. If this production is to be maintained, will it be possible to employ fewer men and women if the number of factories is reduced to $\frac{x}{3}$. It is obvious that such concentration is possible, but the question is, will it be sufficient to free, as is anticipated, 500,000 to 750,000 employees for more essential work. To assist in answering this question, the results of an investigation into the food, drink and tobacco trades, contributed by Mr. G. H. Daniels to the Institute of Statistics in August, 1940, may be cited. He found that in July, 1939, 554,330 persons were employed in these industries. A reduction of output by 30 per cent. would have released 33,260 persons, if it had been distributed over all the firms. By concentrating production in the most efficient units, however, he calculated that no less than 202,340 workers could be released. These figures are admittedly estimates. Nevertheless, there is no reason to doubt their essential accuracy, since we may admit with the rationalists that more efficient equipment and better organisation permits the same production with fewer personnel. One other merit of the plan will be that it should cheapen production and thus obviate price increases to the consumer.

No objection can be raised to the proposals, therefore, on the score that they will not attain the object of releasing men and women for other purposes. There are other factors, however, which must be discussed, if only for the reason that, unless the scheme is to be permanent, ways of retreat to the conditions with which industrialists have long been familiar must be left open. Dealing with this point, Mr. Lyttelton has promised that the closed factories will be kept ready, so that they can be started up again as soon as possible after the war; and that the departments concerned will take all measures open to them to assist this speedy reopening. Meanwhile, the Board of Trade is to keep a record of the factories closed down and the Ministry of Labour is similarly to schedule the transferred personnel, so that they may be able to resume their old employment after the war.

This, however, is not, and cannot be, the whole story, for it takes no account of that illusive and intangible commodity, goodwill. It is around this difficulty that a great deal of criticism will centre; as indeed, it is doing already. Is it possible, in practice, it may be asked, to re-design the machine in the way suggested and then to reverse it when the time comes so that progress may once again be made along the old lines? Is it possible to shut down two out of three factories without adversely affecting the fortunes of their owners, and to restart them, after they have been closed for a period of months or, more probably, years, with no more trouble than is caused when they are shut down after the annual Wakes? Is it possible to hand over the production of goods to a competitor for a like period and then revert to competition once more without any shock to the system? This particular difficulty could be partially overcome, perhaps, by some scheme for the preservation of brands and trade marks. There has been no hint, however, as to whether this will be done and, if it were, complete protection would not be provided. For instance, assume the case where consumer A has always purchased the products of manufacturer B, partly out of conservatism and partly because they fairly met his requirements. Under the new scheme, he is forced to purchase the products of manufacturer C, for they are the products of the latter, however they may be branded, and this knowledge cannot be concealed. A now finds, either that C's products suit him better than those of B or, at worst, that there is so little to choose between them that it makes no difference. When the war is over, conservatism will, therefore, once again tend to exert its influence, and make him stick to C as once he stuck to B. What then happens to B's business and how is he to be compensated for the harm which has inevitably been done him? It is questions like these which will be asked when the approval, which always greets such spectacular proposals, begins to be tempered by consideration. It is no answer to say that "there is a war on."

In this connection, it must be remembered that at present the scheme, if not truly voluntary, will depend for its success in large measure on the co-operation it receives from the industry. Mr. Lyttleton has appealed for that co-operation and is looking to those concerned to effect the necessary measures of concentration in consultation with the Government departments. This is wise; for it is obvious that the firms themselves are in the best position to frame plans in the light of their knowledge of their own capacity and circumstances. "Should," however, is not the same thing as "will"; and history shows that the reorganisation of an industry by voluntary efforts, when the interests of its members are unidentical, is by no means easy and may easily prove to be impossible. While, therefore, voluntary effort may well be given a chance, matters are too urgent to admit of long delay or of anything in the nature of filibustering. Compulsion cannot be kept too much in the background and must, if required, be applied without delay.

Fortunately, at the moment, it would seem that drastic steps will be unnecessary. On the day after he made his statement in the House of Commons, Mr. Lyttelton discussed the problem with representatives of the Federation of British Industries and meetings have been subsequently arranged with the employers in the pottery and other industries. In order to help the Board of Trade in carrying out its task, the scope of the Export Council is to be expanded and it will be renamed the Industrial and Export Council. A committee will be informed on which the Parliamentary Secretary for Raw Materials of the Ministry of Supply and a representative of the Ministry of Labour will sit. The number of business members on the Council will also be increased with the sensible intention of ensuring that the industries concerned in carrying out the difficult task of re-organisation may be guided by men with experience of their problems. On paper, therefore, the prospects of the scheme are good, but everything will depend on how the difficulties that exist, and they are many, are tackled. Anything that would cause bad feeling and friction and still more hardship and injustice must be avoided. The Government have the powers to inaugurate this industrial revolution; and no one will dispute their right to exercise them; it is essential, however, that those powers should be exercised with discrimination and that nothing should be done which will render the return to more normal methods harder than it inevitably will be.

NOTES.

GOVERNMENT BUILDING CONTRACTS.

THE objections urged against the "cost plus" form of contract by the Select Committee on National Expenditure in their Fourth Report, which was the subject of an article on page 131, *ante*, are strongly supported by the instances of wasteful spending cited in the Fifth Report, which has been made public during the past week. It deals with the construction of hutted camps to accommodate the force of Militia which was brought into being by the Military Training Act of 1939, which received the Royal Assent on May 26 of that year. It was considered essential that the Militia should not continue in tents later than October 1, and, for this reason, rapid construction of the camps was essential. The War Office entrusted the work to large firms of contractors, experienced in undertakings of the kind, on the basis of cost plus fee, and it was estimated that the total cost of the programme, including extra works staff, training facilities, etc., would be some 21,000,000*l*. In fact, the cost was four times as great; and, the Committee add, it does not appear that the desired speed in construction was achieved by the adoption of this form of contract, although speed had been the principal inducement to adopt it. They state their opinion that considerable savings might have been effected if more preliminary work had been done in anticipation of the actual decision to build the camps—the need for which was evident some time in advance; for example, any preliminary expenditure on the consideration of possible sites, or of the lay-out of the camps, would have been saved many times over when the construction was eventually authorised. Moreover, much of this work consisted of surveying, architectural and building problems rather than military ones, and would have been better entrusted to competent civilian hands than to the overpressed staff of the War Department. Among their recommendations for the more efficient conduct of future work of a similar nature, the Committee urge again that "cost plus" contracts should not be made "except in minor cases of extreme urgency"; that there should be as little revision of contracts as possible, and that Departments should state their requirements accurately and fully; that greater care should be taken to avoid the use of unnecessarily expensive materials; that supervision should be more thorough (in the instances considered, it is stated to have been "lax"); and that care should be taken in the selection of sites in order to avoid changes of lay-out. In five typical cases, for which comparative costs are cited on a percentage basis, the final costs range from 240 per cent. to 482 per cent. of the original estimates, the greater part of the increases being due to additional works and to increased labour charges.

SHIPYARD LABOUR CONTROL.

The reference, in the leading article on the opposite page, to arrangements for the relaxation of existing demarcation rules of shipyard workers, indicates only a part of the changes that are being introduced in the shipbuilding industry in order to accelerate production. It was announced by Mr. Ernest Bevin, speaking in Newcastle-on-Tyne on March 9, that a transfer of authority has been made, whereby the First Lord of the Admiralty becomes responsible for the employment of all labour engaged in shipbuilding or ship-repairing, on both naval and mercantile vessels. In addition, the men would be grouped in areas and would not be reserved to employment by particular firms; this step, Mr. Bevin believed, would avoid lost time and would give the men greater security, while introducing a system of direction of effort, hitherto lacking. A measure of interchangeability would be required of the men, so that work would not be held up for want of a particular grade of craftsmen, when another man was available who was capable of undertaking it. The men would have a guaranteed weekly wage, so that the operation of the interchange system would not involve individual hardship. An interesting comment was interpolated by the Minister at this point; although this special arrangement was only for the period of the war, he said, he did not think that a reversion would be welcome, after the war, to the old system of restricting "the incoming youngster" to narrowly subdivided occupations. The operation of the interchange procedure would be agreed by consultation between the unions and the management before action was taken in individual cases. It may be observed, in passing, that if Mr. Bevin can bring about a permanent reduction in the number of demarcation disputes, which normally occupy so much of the time of shipyard managements, he will have made a material contribution to the welfare of the shipbuilding and ship-repairing industry. Continuing, the Minister referred to his efforts to obtain another 50,000 recruits for the shipyards, partly by new entries, but largely by inducing men who had left the industry during the years of depression to return to it for the duration of the war. Volunteers were urgently wanted to undertake labouring and semi-skilled work, and he hoped that men of suitable abilities would come forward, recognising it as an opportunity as well as a duty.

POOLING RAILWAY WAGONS.

It is announced that, with a view to improving their present organisation for handling freight rolling stock, the British railways are to set up an inter-company committee and a system of central control. In ordinary times, as is generally known, each of the companies maintained its own control staff for the purpose of tracing the movements of goods stock. Soon after the war began, a pool of certain types of vans was introduced, with satisfactory results. Closer co-ordination is now needed, to deal with the movements of other classes of freight vehicles and their equipment, such as wagon sheets and ropes, and this it is hoped to achieve by the aid of the new committee and organisation. The demands upon the available rolling stock are increasing, making it more than ever necessary to reduce to the minimum all avoidable delays in loading and unloading. The inter-company control will have to deal with the distribution of some 1,250,000 railway freight vehicles and it will be seen, therefore, that its introduction represents one of the most important steps yet taken to enable the railways to handle expeditiously the growing volume of war-time traffic. In spite of the fact that common-user arrangements for certain classes of vehicles have been in use for many years, there is ample evidence that the best use has not been made of much of the wagon stock under war conditions, though this has not been entirely the fault of the companies or due to shortcomings in their organisations. In his speech at the recent annual meeting of the London Midland and Scottish Railway, Lord Stamp complained strongly of the difficulties imposed on the railways by the practice of some Government departments in making heavy demands upon their resources without giving adequate notice of the probable requirements, and of contractors who forwarded 50 wagon loads to a consignee who possessed facilities for loading or unloading only two or three a day. The suggested control may not be effective in preventing such unreasonable demands, but it will, at least, help towards a general improvement by indicating where, on the various systems, the delays are occurring, and where cranes and other mechanical aids to the handling of goods can be employed to the best advantage.

SUMMER TIME AND ELECTRICITY SUPPLY.

Comment on the Home Secretary's decision to impose on the country an extra hour of summer time from May to early August seems, so far, to have been confined to the deleterious effect it may have on farming operations, with the addition that it may be difficult to persuade children to go to bed in daylight. Farmers, it is well known, do not like this partjcular form of daylight adjustment, though by this time they, if not their stock, must have become inured to it. There is every indication, however, that altering the hours of daylight still further will not only be unpopular, but will raise real difficulties. It may be wondered, for instance, what will be the effect on electricity supply undertakings. As we recently pointed out in commenting on a paper by Mr. P. Schiller, which was presented for discussion before the Institution of Electrical Engineers, it is by no means unusual for the system peak to occur in the early morning owing to coincidence of the lighting, heating, cooking and industrial peaks. It is true that, under normal conditions, this unwanted combination usually takes place in the winter, for, in the spring and summer lighting, is not required, even at the early hours of rising which are now becoming more usual, and the temperature may even be high enough to make heating unnecessary. These conditions may, however, be altered by the double shift which has now been decided upon. May is not always as warm a month as poets would have us think and even in June there are mornings when artificial heating is not to be despised. One result of the new arrangement, therefore, may be the appearance of a summer heating load and it will be interesting to see how this modifies the curves of the undertakings affected. The matter is, perhaps, one of academic rather than practical interest as the demand, though larger than usual, is not likely to exceed the value of the winter peak, while the fact that payments to the Central Electricity Board are made on the demands incurred during the three winter months will do much to still any financial qualms that might otherwise have arisen. Nevertheless, it will be interesting to see the results, when the time comes for their publication to be permitted.

PLANNING FOR RECONSTRUCTION.

The statement made by Lord Reith in the House of Lords, on February 26, wherein he outlined the duties assigned to him as Minister of Works and Buildings and the manner in which he was organising the approach to the very considerable tasks involved, provided no more than a sketch of the procedure intended to be followed; but it did indicate that the Minister, with the concentration of purpose which he had already displayed in responsible positions elsewhere, had mapped out to some extent his own course among the rather confused array of post-war problems confronting his Ministry. His own responsibility, he observed, was that of exercising the functions of central planning and co-ordination, and of initiating the work and giving general guidance and supervision; to this end, he was selecting a small central staff, and proceeding with the appointment of a consultative panel of "a dozen or twenty individuals who have special experience in this field." In due course, Lord Reith continued, it would be necessary to have decisions of policy on such questions as the place of agriculture in the national economy, the distribution of industry, and the organisation of transport; these decisions would be applied by planning. The principle of planning, he assumed, would be accepted as a national policy, and for its fruition some central planning authority would be required. The immediate work fell into three groups, namely, the measures required to prevent action, during the war, which might prejudice the work of reconstruction; research, including technological research into building methods and materials; and the examination of defects in the existing system of administration, both central and local, and the consideration of the legislation necessary to permit of planning on a national and regional basis. Under the first head came the appointment of Mr. Justice Uthwatt's committee on compensation, and the prevention of speculation in land values. The problems in the second category included those of urban redevelopment; and the third group involved the extensive task of taking stock of what had been done already, and framing improvements which would enable the system of planning to respond adequately to the demands likely to be made upon it. Many of the matters to be taken into account would concern other Departments; he hoped to press their resources into service, and also to ask for the collaboration of the various professional and technical associations. In none of these proposals, Lord Reith concluded, was there anything which might interfere with the war effort of the Government or the Ministry; indeed, the idea of a planned and ordered reconstruction was surely an added encouragement to war effort.

THE INSTITUTE OF METALS.

THE thirty-third annual general meeting of the Institute of Metals was held at the offices of the Institute, 4, Grosvenor-gardens, London, S.W.1, on the afternoon of Wednesday, March 5. The meeting was formal in character, no papers being presented or discussed. The Chair was occupied by the President, Lt.-Col. The Hon. R. M. Preston, D.S.O., who delivered a brief presidential address at the conclusion of the business proceedings.

REPORT OF THE COUNCIL.

The first matter considered, after the minutes of the previous meeting had been dealt with, was the report of the Council, which concerned the proceedings and work of the Institute during the year ended December 31, 1940. This showed that the members on the roll numbered 2,237, as compared with 2,337 on December 31, 1939; and 2,252 on December 31, 1938. That the roll showed a drop of 100 as compared with the previous year, it was pointed out, was not surprising in view of the removal of the names of members in Germany and Italy. The names of members in countries over-run by Germany had been placed on a suspense list. They were, however, included in the total of 2,237 quoted above, but, in present conditions, they could not contribute to the Institute's subscription income. The Council had to record, with deep regret, the deaths of a number of members, among whom were Professor Sir Harold Carpenter, F.R.S., Sir J. J. Thomson, O.M., F.R.S., Professor Sir T. Hudson Beare, Sir Robert Hadfield, Bart., F.R.S., Mr. Summers Hunter, C.B.E., Mr. G. H. Nisbett, J.P., Mr. E. L. Rhead, Mr. H. L. Sulman, Engineer Commander H. C. Anstey, R.N., O.B.E., Colonel A. J. Bailey, C.B.E., T.D., Mr. J. S. Kincaid, O.B.E., Mr. C. H. Merz, and Mr. L. W. Schuster. The *Journal* had continued to be published month by month from the offices of the Institute, and the high standard of the original papers and of the abstracts published had been carefully maintained by the Publication Committee. Meetings of the five local sections for the session 1939-40 had been held as far as war conditions permitted and the Council was grateful to the local committees for carrying on the work of the sections in difficult circumstances. In this way members had been helped to maintain the corporate spirit by personal contacts that had not been possible through the usual general meetings of the Institute.

HONORARY TREASURER'S REPORT.

The report prepared by the honorary treasurer of the Institute, Lieut.-General Sir Ronald Charles, indicated that the income for the year ended June 30, 1940, amounted to 6,909*l.*, and the expenditure to 6,353*l.*, thus showing an excess of income over expenditure of 556*l.* As compared with the financial year 1938-39, however, the income had decreased by 381*l.*, but, on the other hand, the expenditure had also decreased by 1,219*l.* The donations and other sums received towards the Endowment Fund now totalled 17,303*l.*, and adding to this sum donations due under covenant or otherwise promised, the total became 19,768*l.* Faced with the probability of having to find a substantial sum to balance the income and expenditure account for the current year, owing to the expected loss of subscription income, coupled with the rise in costs of commodities, the Council had appealed to industry for help in order to form a war emergency fund. The response had been most gratifying, and the majority of the subscribers had promised to renew their subscriptions throughout the war years. The appeal had been launched in July, 1940, and would be fully dealt with in the next report.

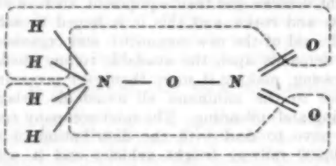
ELECTION OF OFFICERS.

The officers nominated by the Council at the statutory autumn meeting, held in London, on September 18, 1940, were declared to be duly elected for the year 1941-42, namely, as President, Lieut.-Col. The Hon. R. M. Preston, D.S.O.; as vice-president, Dr. W. T. Griffiths; and as members of the Council, Mr. Roosevelt Griffiths, Dr. J. L. Haughton, Mr. F. S. Mitman, and Dr. H. Sutton.

EXPLOSIVES.

IN his lecture on "Explosives," given at the Royal Institution, on Tuesday, February 11, Professor G. I. Finch explained how the known qualities of different types of explosives were related to their composition and chemical behaviour. The lecturer pointed out that an explosive substance did not necessarily contain a more concentrated store of energy than ordinary combustible fuel, but it could release this energy in an extremely short time. A concrete example was an exhibit of two bottles, one three and a half times the capacity of the other. If the larger contained nitroglycerine and the smaller petrol, Professor Finch stated, the actual store of energy would be the same in each case, but, as pointed out by Professor Bernal in his lecture on "The Physics of Air Raids,"* while the petrol when burnt with sufficient oxygen normally liberated its energy during a 50-mile run of a motor car, the explosive contained its own supply of oxygen and released its energy in a minute fraction of a second and thus caused devastation instead of producing steady work.

Explosives of the present day, the lecturer continued, were not necessarily materials capable of self-combustion, but were frequently compounds, the actual molecules of which were disintegrated by suitable stimulus, although quite stable in normal circumstances. The energy of stimulation, however, was far transcended by that resulting from the molecular disruption. Moreover, the atoms or molecules so released were usually gaseous, and therefore enormously greater in volume than the compact solid or liquid charge, with the result that intense pressures were rapidly produced. Thus, an explosive was a store of chemical energy released by an



extremely rapid atomic rearrangement. In other cases, oxidation also occurred together with the molecular turmoil, the necessary oxygen being combined in the original molecule. Combustion therefore proceeded with an intensity far surpassing anything possible with mere mechanical mixtures of combustible and oxygen-producing ingredients. Gunpowder was a mechanical mixture, containing carbon and sulphur powders to burn and nitre to provide the necessary oxygen once inflammation has started. The ingredients, being intimately mixed, were in a condition to produce intense combustion, which, in a confined space, became explosive from the mechanical pressure of the carbon and sulphur dioxides which were the products of combustion.

To illustrate the effect of intimate mixing, two samples of a mixture of chlorate of potash and sugar were prepared. In one, the ingredients were present as rough granular crystals, while in the other the two components had been finely ground before mixing. When the two charges were ignited, the coarse sample burnt with spluttering deliberation, while the fine material burnt almost instantaneously. The more intimate oxidation within the molecule itself was exemplified by ammonium nitrate, the molecular arrangement of which the lecturer illustrated by the diagram reproduced herewith. Two central atoms of nitrogen are linked by an atom of oxygen, and on each side are joined four atoms of hydrogen and two of oxygen, respectively. These combined into two molecules of steam, as shown by the dotted lines, leaving the central group $N=N$ with O below, which is the dentist's gas, nitrous oxide. The whole rearrangement could release far more chemical energy than was required to stimulate it; and an explosion then resulted. The stimulus in this case must, however, be very strong. By ordinary careful heating in a test tube the substance decomposed quietly enough into steam and nitrous oxide as above. It was, in fact, not until 1924 that its explosive potentialities were thoroughly realised in the well-known Oppau explosion. Several thousand tons of the substance had been accumulated in a compact form and was apparently being more or less "quarried" for distribution, when the whole mass detonated with the most disastrous results ever recorded from a single explosion.

Two important explosive substances in which the materials for actual combustion were not present in the molecule, the lecturer stated, were the acetylides and the azides; fulminates belonged to the intermediate class where both oxidation and molecular rearrangement occurred. Lead azide and mercury fulminate were largely used as detonants, as they conveniently provided the disruptive stimulus to the molecules of many explosives. The constitution of these detonants is given below.

$C \equiv N - O - H$
Fulminic Acid.

$N \equiv N = N - H$
Hydrazoic Acid.

$H - C \equiv C - H$
Acetylene.

The concentration of combination links among the atoms themselves (instead of being spread among other atoms) was an indication of their relative instability and potential atomic energy, on rearrangement to a more distributed and firmer grouping. The acids themselves were not suitably stable but were used as salts, mercury or lead, etc., replacing the hydrogen atoms. These salts released their energy so quickly as to set up a shock or detonation wave when abraded or sharply struck, or even when ignited in the open.

Such detonating materials were quite unsuitable for explosive charges. An explosive, to be of practical value, must be safe to handle and transport in fair bulk; it must not explode until required, and then only with a controlled stimulus of a definite and unusual nature. Some common materials had dangerous potentialties, but were safe because they were only employed in small separate quantities. Ordinary match composition was an example; a sample of this when struck on an anvil cracked off quite intensely, and even safety-match composition could be made to explode if struck sufficiently sharply. A small particle of silver azide on a strip of paper detonated on pulling the paper apart, as in a cracker, and a few specks of the so-called nitrogen iodide (iodine azide), prepared previously in the wet state and left to dry on blotting paper, exploded intensely when just touched with a stick. Here then was a violent explosive but one of no practical utility because it was far too sensitive.

Nitroglycerine was much more stable; it was a typical nitrated body, the three oxyhydrogen groups of glycerine (a triple alcohol) being replaced by three nitrate radicles, a merely combustible molecule being thus transformed into a molecule containing combustible and oxygen and capable of rapid self combustion. The constitution of the molecule was as follows:

$$\begin{array}{l} H_2C - ONO_2 \\ | \\ HC - ONO_2 \\ | \\ H_2C - ONO_2 \end{array}$$

A strip of paper wetted with nitroglycerine, when struck on an anvil, was blown apart, but the remaining pieces responded to further blows, showing that the action was local, being confined to the actual area of impact. This, however, demonstrated a great objection to liquid explosives from the spreading of danger by accidental spilling. Nitroglycerine also became dangerous when it froze, as it might easily do under ordinary winter conditions, since the friction of the liquid between the sharp crystals might then cause it to explode. It was far more handy when made into "blasting gelatine," by combining it with a suitable nitrocotton, being then a flabby but coherent translucent material, which, however, was still responsive to a sharp hammer blow. Guncotton alone, made by the action of strong nitric acid on pure cotton wool, was very safe to handle when wetted with 20 per cent. of water.

* See ENGINEERING, vol. 150, page 514 (1940).

Such facts led to a classification of explosives according to their various uses. Sensitiveness reflected stability, being a measure of the energy required to shake atoms out of strained positions to an extent necessary for them to release the greater energy of rearrangement to more stable configurations. It was difficult to measure exactly; nitroglycerine, for example, was more sensitive to sudden heat than to violence; lead azide had opposite properties. It was necessary, therefore, to define the nature of the test. First then, the lecturer asked, how did explosives behave when simply ignited in the open? Of the series that burnt quietly, the following were tested during the lecture: gunpowder, nitroglycerine on a strip of blotting paper, and cordite which had a composition somewhat similar to that of blasting gelatine but was of a much harder horny consistency. A stick of this could be ignited like a candle and held in the hand and, if thin enough, could be snuffed out with the fingers. Finally, in the quietly-burning class, were blasting gelatine and guncotton. The latter, since the products of its combustion were all gaseous, would puff off harmlessly on the palm of the hand. In a second class were the substances which exploded even when ignited in the open; of these, silver azide and mercury fulminate were demonstrated. A speck of silver azide on a strip of cardboard was touched with a small flame; there was an immediate detonation and the cardboard was torn into fibres. A loosely-covered tin can in which an ordinary fulminate cap was heated was thrown off its tripod. This second class were the detonants.

When tested by their behaviour on ignition in the open, explosives, therefore, fell into two classes. The combustion of the first proceeded uniformly from layer to layer, while in the second there was a rapid acceleration of combustion to detonation point. In this latter case, the typical steep-fronted shock wave was produced with an adiabatic compression sufficiently intense to raise the temperature momentarily to over 10,000 deg. C., and to produce pressures of the order of 150,000 kg. per square centimetre. The second class were useful only as detonants, while the first were controllable and practicable high explosives. The detonants were not more powerful; nitroglycerine and cordite had four times the energy of fulminate or lead azide, but the detonants gave off all their energy in one step, yielding products not prone to further dissociation at high temperatures. It was, therefore, by confining the quietly-burning class that we made them explosive, because they were then suddenly heated; if nitro-glycerine, instead of being spread out on paper as in the previous experiment, were confined in a capillary glass tube and the end of the liquid streak were passed through a flame, a violent explosion resulted. If a drop were allowed to fall from the capillary tube on to an iron plate heated at one end nearly to redness, a position could be found where the drop would explode violently on contact, although on each side of this position the liquid either rolled off in the spheroidal state where the plate was overheated, or merely ignited. Guncotton, T.N.T., ammonium nitrate, all behaved similarly and were thus classed as high explosives.

There was a further class of explosives known as propellants, which could not be induced to detonate even when confined or suddenly heated; for example, no position on the hot plate could be found where a filament of cordite would explode. The burning of a charge of propellant proceeded at an accelerating speed if the material were porous, because the hot products of combustion were forced into the pores of the material and thus acted on an increasing surface. This happened in the case of a granular material, such as gunpowder, but could not occur with cordite, which was a dense horn-like plastic. The rate of burning of a charge of cordite, however, could be controlled by varying the length and cross-section of the sticks or tubes into which it was generally formed. A complete round for a gun, therefore, consisted of all four classes of explosive; firstly, the cordite, or similar material, which burnt at a relatively slow uniform rate and ejected the projectile from the gun; secondly, the high explosive with which the projectile was filled and which, because it must do its work very rapidly, must finally detonate; thirdly, the small amounts of detonant, such as lead azide, required to initiate detonation of the shell filling; and, fourthly, the percussion-cap filling, which ignited a powder charge, the flash of which ignited the propellant.

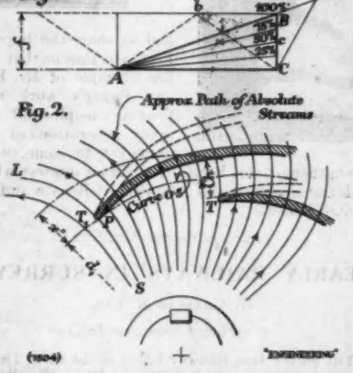
The lecturer concluded by pointing out that high explosives were selected for different uses according to their sensitiveness to detonation. Some responded immediately to detonation alone; others, such as moist guncotton, T.N.T., and ammonium nitrate (Amatol), required further stimulus or "gaine" in the shape of a small amount of a high explosive of intermediate sensitiveness. They could then be selected for different tasks, especially for such contrasted industrial requirements as quarrying and coal mining, where very different degrees of violence were required. Contrary to the popular belief, the use of high explosives for industrial purposes was far greater than for warfare.

LETTER TO THE EDITOR.

THE EFFICIENCIES OF THE CENTRIFUGAL PUMP.

TO THE EDITOR OF ENGINEERING.

SIR,—When dealing with a subject such as this, where so many different views are held on the actual operating conditions, it is doubtful if Mr. Jennings' plea for a more uniform and logical treatment will be realised; even the standardisation of the nomenclature to be adopted would be akin to the evolution of a universal language. The résumé of the information illustrates these differ-



ences best in the treatment of the loss due to the wetted surfaces of the impeller, in classifications A and B. Mr. Jennings states that both classifications appear to be quite logical because the disc losses are hydraulic in character. Might the same argument not be applied to properly lubricated bearings and glands, all three losses being due to the shearing of fluid particles?

A third classification may be put forward for consideration, where the loss due to the total wetted surface of the impeller is treated as a mechanical loss. Reference to Fig. 2, herewith, shows that the fluid does not flow in the impeller channels, but that the vanes are being driven through the absolute streams, making the losses more mechanical than hydraulic. A slight hydraulic effect does occur, as the channel friction reduces the relative velocity, with a corresponding increase in the absolute velocity at exit, accompanied by an increase in head. This increase is just the reverse of the effect mentioned in Sherwell and Pennington's paper.

The relative velocity will be an important factor in estimating the power absorbed by impeller friction. This raises the question, can the relative velocity be varied at will? The earlier writers, by adopting the full-line diagram, A B C, in Fig. 1, and assuming that the fluid would approach the vanes radially and completely fill the channels, would appear to have been more logical than the modern authors, who advocate an allowance for pre-rotation in the eye and recommend the dotted-line diagram, A b C, with the object of reducing the relative velocity. Fig. 2 shows full-line and dotted-line channels corresponding to their respective diagrams. Consider the full-line channel, and the fluid particle P flowing along the absolute stream line S L with the velocity f ft. per second: the radial distance x inches from d_1 that P moves in the time, t seconds, taken by the vane tip T to occupy the position T_1, is given by x in. $= \frac{720 \times f}{\text{r.p.m.} \times z}$; z being the number of vanes. It will be seen that the diagram is fulfilled, since the depth of fluid over the tip T is just equal to C h, the channel height provided.

Now consider the dotted channel, with its increased inlet angle and an area provided to pass the normal quantity at the reduced relative velocity A b. The radial velocity f is common to both diagrams, so that x, the depth of fluid over the tip, and the relative velocity with the value A B remain unchanged. It is difficult to see what good object is to be attained by blindly following the modern trend.

The above formula shows that the relative velocity varies little until the depth of fluid over the vane tip equals C h. For an output of 50 per cent. of the normal, the curve marked 0·5 shows the relative positions of P and the tip T during the interval t seconds, giving an inlet diagram A c C. This uniformity will help to simplify the calculations of the disc friction.

This question relating to the relative velocity has wandered away from the logical treatment of efficiencies, etc., asked for by Mr. Jennings, but as the correct interpretation of the physical behaviour and the efficiencies are so intimately connected, you may, perhaps, excuse the digression.

Yours faithfully,
G. URE REID.

Inzevar,
Dollar, Clackmannanshire.
February 28, 1941.

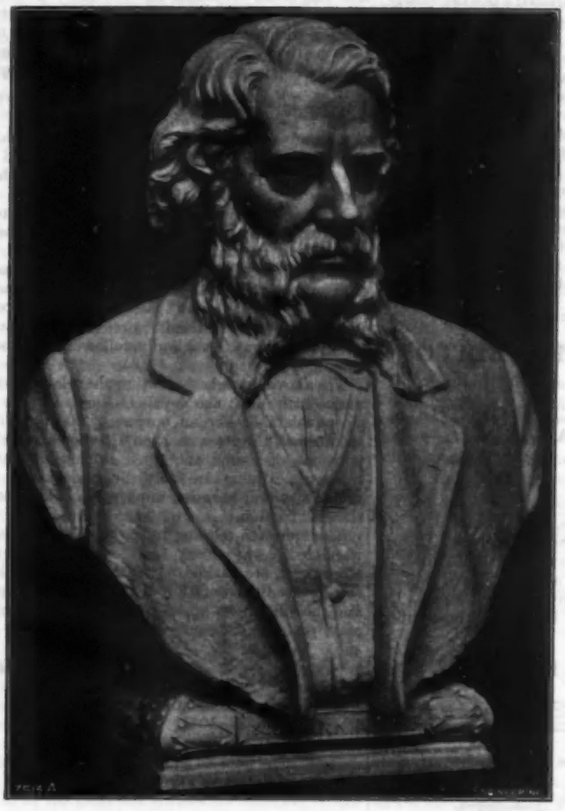
OBITUARY.

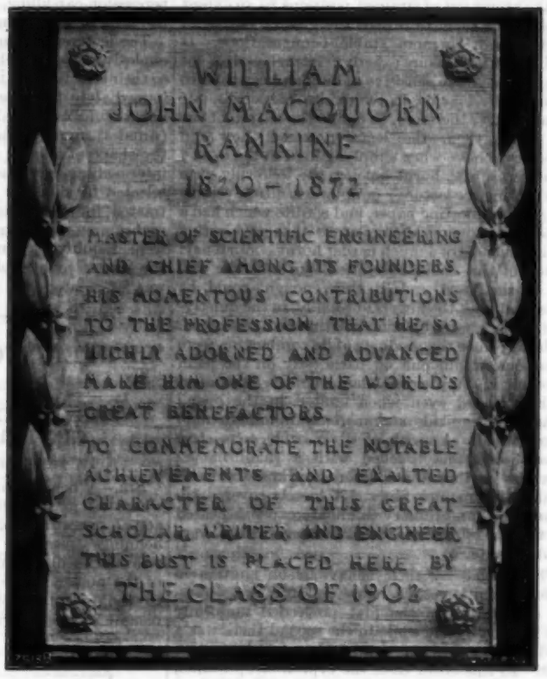
MR. R. D. GIVEN.

WE note with regret the death of Mr. Ralph David Given, which occurred on February 28. Mr. Given, who had been one of the leading engineers of Messrs. The British Thomson-Houston Company, Limited, for the last 28 years, and was serving as Head of the Industrial Engineering Department, Rugby Works, at the time of his death, was born at Musselburgh, Midlothian, on May 8, 1882. He was educated at Daniel Stewarts' College, and, after leaving school, served a six years' apprenticeship in mechanical engineering at the works of Messrs. James Bertram and Son, Limited, paper-mill engineers, Leith, and the early experience thus gained with paper-making and similar machinery proved very valuable in later years when developing electric drives for paper mills and other plant. Meanwhile, he continued his technical education at Heriot-Watt College, Edinburgh, and in April, 1907, at the age of 25, gained a Whitworth Exhibition, and went to the University of Edinburgh. After his university training, Mr. Given entered the drawing office of Messrs. W. H. Allen, Sons and Company, Limited, Bedford, where he was engaged on the design of high-speed engines, electric-lighting installations and pumping plant. In 1909, he went to South Africa to join the staff of the Central Mining and Investment Corporation, Limited, Johannesburg. There he was made chief draughtsman and gained some valuable experience in the electrical and mechanical-engineering equipment of the gold mines.

On returning to England, in June, 1913, Mr. Given joined the staff of the British Thomson-Houston Company, in what was then known as the Power and Mining Department at Rugby. This department developed into the Industrial Engineering Department and, as its chief, Mr. Given utilised his wide experience in solving many difficult problems relating to the electric driving of mining machinery, rolling mills and paper-making machinery.

MEMORIAL TO W. J. M. RANKINE.





MEMORIAL TO W. J. M. RANKINE.

The high standing of Scotland as a nursery of engineers and a manufacturing centre for engineering products is undoubtedly due, in no small measure, to the contributions made to the scientific study of engineering by a comparatively small band of Scottish pioneers, pre-eminent among whom is William John Macquorn Rankine; and it is particularly gratifying at the present time to record the action of the class of 1902 at the Virginia Polytechnic Institute in presenting to their college the fine bust of Rankine which we illustrate above. The suggestion that they should do so originated with Professor William H. Rasche, an honorary member of that class, and met with a ready response. Mr. Bryant Baker, a former student at the City and Guilds College and the Royal Academy of Arts, London, who has resided in the United States since 1916, was commissioned to execute the bust, which is in bronze, mounted on a marble pedestal. The presentation was made on June 8, 1940, by Major W. P. Tams, on behalf of the class of 1902, in the Patton Engineering Hall of the Institute, and the bust was then unveiled by Miss Ariel St. Clair Close, secretary to Colonel Earle B. Norris, Dean of Engineering. Mr. Charles C. Penrose, senior vice-president in America of the Newcomen Society, delivered a memorial address, in which he outlined the principal events of Rankine's career and his outstanding contributions to engineering science. In this somewhat iconoclastic age, when the tendency of much historical research has been rather to minimise the debt that progress owes to many of the almost legendary figures of the early days of applied science, Rankine's reputation has increased, if anything, with the wider appreciation of his great gifts, the catholicity of his interests and the soundness of his work in linking the science and practice of engineering. It is with the greatest pleasure, therefore, that we record this tribute of the Virginia Polytechnic Institute to his memory, and we share the hope of Professor Rasche that this fine example of Mr. Bryant Baker's work may provide inspiration for many generations of students yet to come, while strengthening the bonds of common interest which link the engineers and scientists of Britain and the United States.

EARLY RAILWAYS IN SURREY.*

By Charles E. Lee.

(*Concluded from page* 185.)

The Surrey Iron Railway began at the River Thames with a dock or basin between the River Wandle and Fairfield-street, and extending to York-road. The railway emerged from the wharf area into York-road, passed the Ram Brewery, crossed Wandsworth High-street, and went a little way along Garratt-lane before crossing the River Wandle to serve the flour mills. It then crossed back over the Wandle into Garratt-lane at a point just beyond Allfarthing-lane, crossed Garratt-lane itself, and ran on the east side of that thoroughfare, but cut off the sharp bend, and passed through the site of the present Earlsfield station (Southern Railway). When this section of the London and Southampton Railway was opened, on May 21, 1838, there was no station here and the newer railway crossed over the S.I.R. on an arch of 22 ft. span, 15½ ft. high. The tramroad continued along the east side of Garratt-lane to Burntwood-lane, then crossed Garratt-lane again, and kept on the east side of Summerstown. It crossed Plough-lane, and ran close to the footway called Mead Path which emerges at Colliers Wood. The line then crossed the Merton-road on the level and went along Church-road to Mitcham, following the course of Ravensbury Path and Baron Walk, and crossing the Sutton High-road at a point adjacent to the present Mitcham station. Here there is a path called Tramway-lane, which is either the old course or, more probably, a path alongside it. From Mitcham station the present Wimbledon-Croydon railway uses substantially the S.I.R. track through Mitcham Junction and Beddington Lane stations to the Croydon gas works, and all trace of the old line is lost. From the gas works the site of the S.I.R. is represented in part by Factory-lane, but thence to the terminus at Pitlake the course cannot be traced.

* Paper presented to the Newcomen Society, London, on December 11, 1940. Abridged.

Near Mitcham Junction station the branch line led off in a southerly direction, past the Goat Inn at Beddington Corner, and thus reached the mills at Hackbridge, terminating at the bridge over the Wandle. The line is remembered here by Tramway-path and Tramway-terrace.

The route of the C.M. and G. line from Pitlake Mead follows closely the main London-Brighton road. The names of the present roads give a general idea of the route through Croydon: Lower Church-street, Elis David-road, past Croydon Parish Church; Church-road (formerly called Tramway-road); behind Southbridge and Barham roads; across Haling Park (here the route is very near to the Brighton-road); and between the Brighton-road and Avondale-road. The front of the new Whitgift School building, opened in July, 1931, is on the line of route. From here southward the railway was carried on a slight shelf in the face of the hill. In the neighbourhood of Purley station, the track diverged farther from the Brighton road so as to cross on the level another valley road converging on that point. Once this was passed, the line returned to its former course. About a mile farther south the Chipstead Valley-road entered the Brighton-road, and here it was not possible to effect a crossing on the level. After a slight divergence westward, the line swung sharply round to the south-east and crossed the Chipstead Valley-road by means of a bridge with embankment approaches. This bridge forms the subject of the only illustration of the line extant, a water-colour by G. B. Wollaston, dated 1823, in the Croydon Public Library. This embankment and bridge brought the line through the grounds of what is now Cane Hill Asylum back to the Brighton-road. The latter gradually rises here until, near the Ashdown Park Hotel, it has reached the level of the shelf upon which the railway was built. Opportunity was therefore taken to cross over on the level from the west side, which had so far been followed, to the east side. The track for the next mile and a half coincides with the main London-Brighton railway. When within a mile or so of Merstham, the rise of the downs necessitated a cutting, 30 ft. deep in places. On reaching the outskirts of Merstham, the railway turned sharply to the south-east to its terminus at the Greystone Lime Works.

So far as existing traces are concerned, there is little to be said for the route of the Surrey Iron Railway itself, as most of the land has since been occupied by buildings, and footpaths and names such as "Tramway Path" (already mentioned) are the main modern indications of the route between Wandsworth and Croydon. At Pitlake, however, an interesting survival exists in the small building known as 132, Waddon New-road, now the property of the Southern Railway Company. There can be little doubt that this was an original toll office of the Surrey Iron Railway Company; in fact, there is still a small toll window in the north wall.

It is a two-storey brick building of massive construction, the window sills, for example, being of marble. A peculiarity is that the north-eastern corner is cut away and rounded on the ground floor, although not on the upper storey. It is possible that the rails curved sharply at this point and that the rounding of the building was intended to obviate damage to overhanging loads.

Of the C.M. and G. Railway there are considerably more traces to be found. It is a fact familiar to most seekers of ancient tracks that almost any definitely marked feature across country, such as a bank, tends to become a property dividing line, and this, in fact, has occurred in the case of the C.M. and G. Railway. For many miles there is an almost continuous passage behind houses and between properties. Furthermore, this path is in many cases continued by definite shelving along the hillside, on open land. In some places all such traces have apparently disappeared until examination be made of the vegetation, when it is found that there is a belt of a different kind of grass along the line of route; this is more noticeable when field flowers are in bloom, as these grow in profusion everywhere else and avoid the path of earth which had been beaten hard during its three decades of use as a railway. Having satisfied myself of the existence of so many indications of the route, I chartered an aeroplane in 1931 and flew over some of the more important town sections. From the air a nearly-continuous track may be traced to a surprising extent.

Through the central parts of Croydon the track has long since disappeared, although in the main it has not been built over and is now occupied by a succession of roads. In Haling Park the exact path may be identified by differences in vegetation. Immediately southward of Haling Park, a lane known as Avon-path runs for about a quarter of a mile between the gardens of houses facing Brighton and Avondale roads. The course of the line is continued across Haling Down as a well-defined track which afterwards extends behind some modern houses and is used as access to their garages. On the open land beyond, a slight terracing indicates the course and, near the South Croydon tramway sheds, reveals a definite turn-out. At this point there would seem to have been a depot of some size. The rear garden wall of three of the houses here gives evidence of having been constructed as a retaining wall for the railway embankment, while on top of the embankment or shelf two sidings appear to have existed alongside the main line. Near Purley tram terminus the railway ran across a meadow, now a playing field, at the northern end of which four of the original sleepers and two sections of rail have been placed in position on the line of route and protected by fencing; an adjacent notice board states briefly what the relics are. South of Purley station evidence of terracing may be found at various points.

In the course of the 4½ miles from Croydon to Coulsdon the track has arisen 150 ft., and in the latter place coincides with the 300-ft. contour line, and is therefore well above the Brighton-road at the point where the Chipstead Valley road diverges. In order to cross the latter, the first serious engineering work became necessary, namely, the bridge over the road with embankments on each side. The bridge has disappeared, but a portion of the eastern arm of the embankment still remains in the grounds of Cane Hill Mental Hospital. Apart from traces of terracing there is little to be seen for the next 2 miles, and from the point near the Ashdown Park Hotel, where the C.M. and G. Railway crossed from the west to the east side of the Brighton-road, the present Southern Railway tracks occupy the site of the earlier line for about 1½ miles.

Then we come to the largest remains—a cutting. A refreshment house called Mount Pleasant Tea Rooms stands in the actual track. Alongside is the first of three surviving brick bridges which carried side roads across the railway. All three bridges are nearly buried. Despite this filling-in process, there are lengthy sections of sunken way yet to be seen. For the most part, this cutting is parallel with and near to the Brighton-road, but as Merstham is approached the road and railway diverge for a short distance, coming together again near the Jolliffe Arms. At this point the railway finally forsook the Brighton-road and turned in the direction of Godstone. As already mentioned, it terminated at the Greystone Lime Works. Here there are a number of old stone cottages which local tradition asserts were used originally as stables for horses employed upon the railway and were converted from stables into dwellings after the railway was abandoned. Many stone sleepers are scattered throughout Wandsworth, Croydon, Beddington, Purley, Coulsdon and Merstham. At Croydon Central Bowling Green an outhouse and surrounding walls are constructed almost entirely of stone sleepers; another sleeper lies near the Star Inn at Hooley; several are at the Wandsworth Public Library, and others in the grounds of Ashdown Park Hotel. Relics preserved in museums, etc., include the toll sheet and sections of rail, at South Kensington.

LABOUR NOTES.

FAR-REACHING Government plans for the stimulation of the nation's war effort, by concentrating non-war production in fewer factories working full time, were explained in the House of Commons on Wednesday last week by Captain Lyttelton, President of the Board of Trade. Under them, one firm, in order to free labour, factories and plant for war production, will, in addition to its own work, do that of two or three others, crediting the accounts of those other firms with the results and preserving their trade marks on their quotas of goods. Records will be kept of all factories closed down, and everything possible will be done to ensure that their goodwill is retained and that they are in a position to re-start production on their own account after the war. The possible springing up after the war of new firms doing similar kinds of work will be guarded against. Between 70 and 90 industries are involved, and the effect of the operation of the scheme will probably be, it is estimated, to release about 750,000 people for work of national importance. Young women are regarded as most valuable in munitions. Older women and women who are married and have homes to look after, will, it is expected, be left as far as possible in their present occupations in order that families may not be broken up. Released workers will, as far as possible, be found work of national importance in their own neighbourhoods.

The Government was confident, Captain Lyttelton said, that those concerned would carry through these group arrangements in a manner that mitigated the hardships inevitable in the process of contraction. In pursuance of that policy, the Board of Trade, in association with the Ministry of Labour, would open discussions as soon as possible with representatives of employers and workers in the industries concerned as to the degree of concentration which should be achieved and other matters arising. For example, the factories to be left in production should not be in districts where the demand for labour for munitions was relatively heavy. In order to help the Board of Trade to carry out its task, the scope of the Export Council was being extended and that body would be renamed the Industrial and Export Council. A committee of the Council would be formed, including among its members the Parliamentary Secretary for Raw Materials of the Ministry of Supply and a representative of the Ministry of Supply and National Service.

The Government, the President went on to say, was looking to the industries themselves to co-operate by formulating proposals for effecting the necessary measure of concentration, in consultation with the Government departments concerned. The firms themselves should be in the best position to frame plans in the light of their knowledge of their own capacity and circumstances. "At the same time," he added, "the Government accepts ultimate responsibility for seeing that the necessary measure of concentration is achieved; and when firms are either unwilling or unable to meet the situation by their own efforts, the Government will be prepared in the last resort to impose the re-organisation which circumstances require."

In an Order issued on Thursday last week—"The Essential Work (General Provisions) Order, 1941"—the Minister of Labour and National Service gives details of the scheme of employment control which he outlined in a recent speech in the House of Commons. The Minister may schedule any undertaking which is engaged on "essential work" as defined in the Order, if he is satisfied that it is expedient to do so as a measure for securing the defence of the realm, the efficient prosecution of the war, or the maintenance of supplies or services essential to the life of the community. Undertakings may be scheduled provisionally for three months at a time. Before placing an undertaking more permanently on the schedule, the Minister must, after consultation with the appropriate Government department, be satisfied on the following points:—The terms and conditions of employment must not be less favourable than those provided for by the Conditions of Employment and National Arbitration Order, 1940—by collective agreements, for example. There must be satisfactory provision for the welfare of persons employed or such provision must be in course of being made; this requirement covers welfare both inside and outside the undertaking, including arrangements for housing, travelling, and feeding; it is not intended that the undertaking should necessarily be called upon to make such provision at its own cost; what will be required is that satisfactory arrangements exist or are in course of being made.

When, in the Minister's opinion, it is necessary that provision should be made by an undertaking for the training of workers, such provision must exist or be in course of being made. When an undertaking is scheduled the effects that follow are: (1) The right of the management to discharge and of the staff to leave is strictly controlled and is, in general, subject to permission of a national service officer and to at least one week's notice. (2) A guarantee of a certain minimum time-rate of wages is given, subject to specified conditions. (3) Cases of alleged absenteeism will be dealt with under a special procedure. These provisions apply to all persons in the undertaking including the managerial staffs. Discharge of a workman for serious misconduct will be permitted. In an emergency, but not otherwise, a worker's services may, with his consent, be lent to an undertaking without the permission of a national service officer for a period of up to 14 days.

All workpeople in a scheduled undertaking will have a guaranteed week's wage, but no payment will become due unless the amount otherwise earned for the week by time workers or for the day by pieceworkers (including any payment for overtime) is less than the guaranteed amount. Collective agreements which assure workpeople more favourable conditions will not be prejudiced by the Order. The title to the guaranteed minimum wage is governed by two conditions. The first is that the worker must be capable of, and available for, work. The guarantee will, therefore, not apply to periods of sickness, nor to days of absence without leave. The second condition is that the employed person shall be willing, when work in his usual occupation is not available, to perform any other services which, in the circumstances, he can reasonably be asked to perform. If a person employed in a scheduled undertaking absents himself from work without leave or reasonable excuse, or if he is persistently late at work, the employer may report such absence or lateness to a national service officer, who can then give the employed person directions as to the way in which he should in future attend to work.

The new schedule of reserved occupations is different from previous schedules in respect of both form and effect, and has been framed with the two-fold object of (*a*) Recruiting further men for the Armed Forces, and (*b*) concentrating the residue upon "protected" work. Changes of a two-fold character are embodied. In the first place, the ages of reservation are raised in many occupations by three stages, which will take effect in the course of the current year—probably before the autumn. In the first stage there is a raising of ages as from April 1 next. Men de-reserved at this stage will not, as a rule, be required to join their units before June 1. A further raising of the reserved age will be made in the second and third stages. But it is not expected that men de-reserved at the second stage will be required to join their units before August 1. Those in the third stage of de-reservation will probably have to join up in October. A very rough approximation is that the age of reservation is advanced in the three stages by 5-10 years. The second change is the introduction of a new principle—"protected" work. Hitherto, the schemes have been based entirely on occupation and age; that is to say, a man has been reserved irrespective of the industry in which he is engaged or the work he is doing, and there has been a single age of reservation for all men in each occupation.

Under the new scheme, in many occupations the Schedule will take account not only of the occupation but of the work a man is actually engaged on. In such occupations two ages are now fixed. There is a lower age of reservation for a man of that occupation engaged on work which is "protected" because of its importance to the war effort. A higher age is fixed for a man of that occupation engaged on unprotected work. A register of protected work is to be compiled. The main object of these changes is to ensure that every man of military age reserved from the fighting forces is not merely available for essential work but is actually engaged on it; reservation, in fact, is based now not simply on the occupation or age of a man of military age, but on the importance of the work he is doing. Even "essential national work" is to be carried on by men fit for military duties who are kept out of the fighting forces, only if it cannot be done by an older or less fit man, or by a woman. It is emphasised in the explanatory memorandum that a young man should not be kept even on armament work which could be done either by an older man or by a woman. "Nothing that a woman can do or learn to do, however important, should be allowed to absorb a man of military age."

The total number of unemployed workers registered in February was 580,849—a reduction of 114 757 as compared with the figure for the previous month. Of these, 284,386 were men of whom 200,160 were wholly unemployed, 67,711 temporarily stopped, and 16,515 casual workers.

BEACH TRANSPORT OF LIFEBOATS.

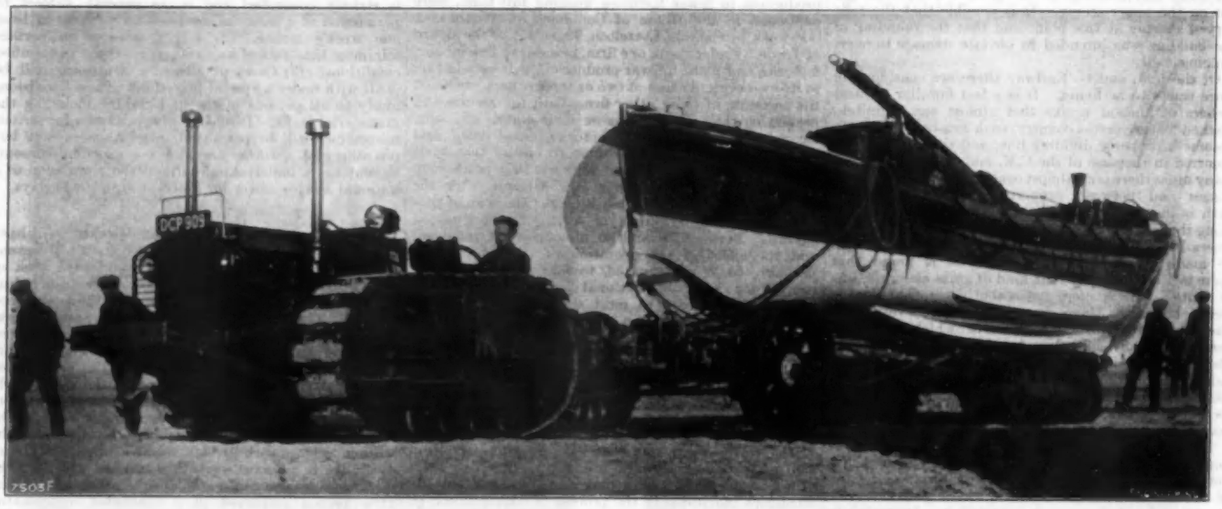


Fig. 8. Tractor, with Lifeboat and Carriage, Travelling over Sand.

Fig. 9. General View of Equipment.

MECHANICAL REQUIREMENTS OF THE R.N.L.I.*

By Lt.-Colonel P. H. Johnson, C.B.E., D.S.O.

(*Concluded from page* 200.)

In order to appreciate the conditions which the lifeboat tractor has to meet in service, it is necessary to give a brief description of an actual launch from the beach. The tractor first hauls the lifeboat to that portion of the beach from which the launch is to be made, finally entering the sea to a depth of perhaps 2 ft. or 3 ft. Turning sharply up the beach the boat is hauled in a shoreward direction until the bow, which is at the rear of the carriage, is facing the sea and at right-angles to the breakers. The tractor is then uncoupled from the carriage and turned round; the front steering wheels of the carriage are locked and the tractor pushes the lifeboat seaward by means of the buffer provided for this purpose. Launching ropes, which are fixed to the stern of the boat and pass round pulleys at the rear end of the carriage, are brought back to the tractor and attached to eyebolts on the launching platform. When the tractor has pushed the lifeboat into the sea to a sufficient depth for launching, and the fastenings of the boat to the carriage have been released, the tractor is driven in reverse up the beach, when the pull on the launching ropes slides the boat into deep water off its carriage. The empty carriage is then hauled up the beach to await the return of the boat. Fig. 8, on this page, shows a tractor, carriage, and lifeboat travelling over a stretch of sand. Fig. 9 shows the position arrived at in preparation for a launch after the tractor has been reversed and placed ready to push the carriage into the sea. Fig. 10 shows the position immediately preceding the actual launch. In this case the beach is steeply shelving, but in some cases the tractor has to push the carriage many hundreds of yards through the water before sufficient depth for launching can be obtained.

Fig. 10. Lifeboat, Carriage and Tractor Immediately before Launch.

In many circumstances the tractor has to be submerged to a depth of about 3 ft., and it may be submerged to a much greater depth. In stormy weather, which is naturally much more usual than otherwise, the breakers may pass completely over the tractor. Fig. 13, opposite, shows a launch on the coast of Holland. The conditions here emphasise the need for a submersible tractor. The tractor must be capable of being submerged for long periods in salt water without any interference with its proper function, and without the entry of salt water into any of the working parts where subsequent trouble would arise. In case the engine is stopped inadvertently, it must be possible to start it when under water, and every other possible precaution must be taken to guard against the stranding of the

* Paper on "The Mechanical Requirements of the Royal National Lifeboat Institution," read before the Institution of Mechanical Engineers, London, on Friday, February 21, 1941. Abridged.

BEACH TRANSPORT OF LIFEBOATS.

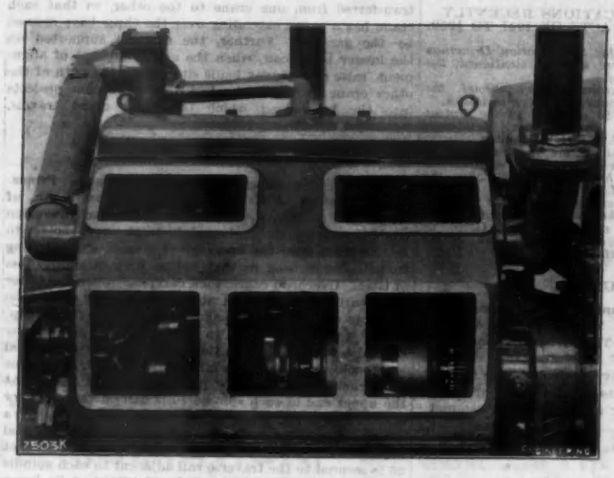


FIG. 11. IGNITION EQUIPMENT, DOORS REMOVED.

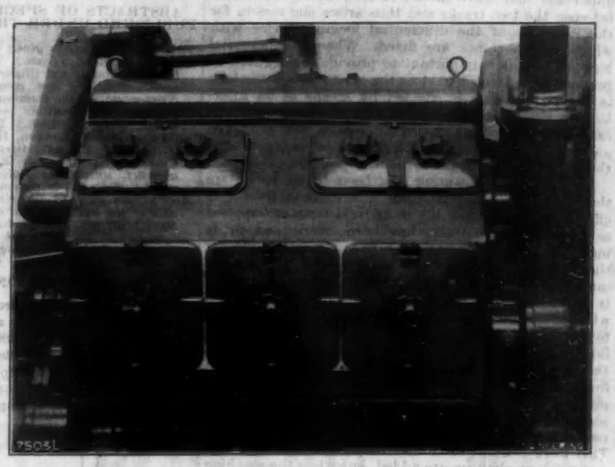


FIG. 12. IGNITION EQUIPMENT, DOORS IN PLACE.

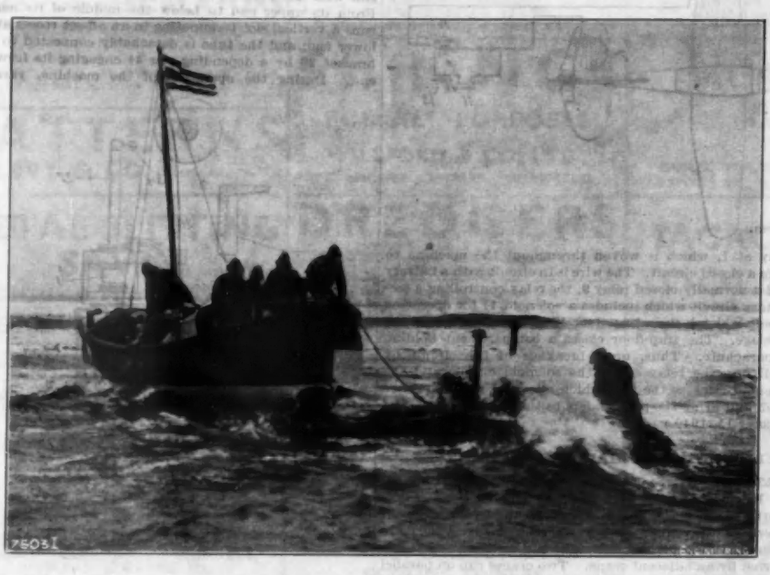


FIG. 13. LAUNCH ON COAST OF HOLLAND.

tractor on a rising tide. Instances have occurred in which inadequately-protected tractors have been stranded in the water, due to mechanical failure, on a rising tide and have been completely submerged for several hours; in consequence, they became filled with salt water and, in some cases, half buried in sand.

The most elaborate and thorough precautions are taken to prevent the possibility of mechanical failure or inadvertent stoppage. These may be summarised as follows. (1) Air for the engine enters through an intake at a height of 7 ft. 6 in. from ground level, the exhaust being carried to a similar height. The air vent for the fuel tank is also carried up to the same height as the air intake for the engine. (2) A large casing of sea water-resisting aluminium is provided on one side of the engine (see Figs. 11 and 12, on this page) for housing the sparking plugs and other electrical gear, which includes dual ignition but does not include the starter motor or battery. Access to this chamber is provided by a series of watertight but easily removable doors. The air intake for the engine is coupled to the forward end of this casing, thus ensuring that cool air passes over the electrical apparatus inside on its way to the engine. (3) The driver's control board is enclosed by a casing in front of the operator, again of sea water-resisting aluminium; movement to the outside of the casing for external operation is made through synthetic-rubber diaphragms. (4) It is impracticable to provide glands for waterproofing the governor gear, as this would interfere with its free working, so this part of the engine is completely encased in a separate housing. (5) The box containing the batteries is placed to the rear of the fuel tank and engine and in front of the driver's control box. (6) In addition to the usual lighting equipment for travelling on the road at night, a powerful searchlight is mounted conveniently for the driver's control, and is an invaluable aid for launching on a dark night. All this equipment and the electrical leads associated with it are specially waterproofed. (7) If, in exceptional circumstances, the tractor is unable to move the boat and carriage by direct haulage, then resort can be made to a bollard, at the rear end of the tractor, which is capable of giving a 10,000-lb. pull with the tractor stationary. Special gear is also provided for anchoring the tractor against the pull of the rope, if necessary, but normally the resistance, with the brakes fully applied, suffices. (8) Every possible inlet for water is "proofed" by some special form of sealing device or connected to the engine air-intake. Many of these sealing devices would have presented far greater difficulties but for the comparatively recent introduction of synthetic rubber. It is also used throughout the tractor for sealing such bearings as those of the weight carrying rollers, bollard, steering shaft, etc. All sliding shafts are provided with glands and stuffing boxes. (9) A special ventilation valve, which is left open when the tractor is not in use, but is closed as soon as the engine is started, is provided to prevent accumulations of petrol gas which might lead to an explosion.

The endless tracks with which the tractor is equipped are of the rubber-jointed variety; the joints are thus immune from the action of sea water, sand, and corrosion. The tractor drawbar is of the laterally swinging variety, pivoted at a point sufficiently forward of the centre of ground contact to ensure that the drawbar pull assists the steering.

The special gear for anchoring the tractor against the pull on the rope, when the bollard is in use, consists of a sprag beam—somewhat longer than the width of the tractor—which is laid on the ground at the rear of the tractor, each end of it being coupled by chains to the tractor frame. The chains are of such length that, when the pull comes on the bollard, the tractor is hauled backwards on to the beam with one track resting on each end of it, so that the combined weight of the tractor and pull on the rope forces the beam into the ground. In this position the chains between the beam and the frame arrest further backward movement. This sprag beam is also adapted for use in emergency as an unditching beam.

In exceptional circumstances, such as mud pockets or quicksand, the surface may be so soft that even track-laying machines will sink sufficiently to cause the weight to be supported by the frame of the vehicle; the tracks then idle round in the mud without propulsive effect. This was a common experience with the tanks used in the Flanders mud during the war of 1914-18, where the problem was made increasingly difficult by the effect on the soil of high explosives. Numerous types of "spuds" or "grousers" were devised for attachment to the tracks in the hope of increasing adhesion, but largely without effect. Scores of tanks were lost due to their inability to extricate themselves from shell craters in swampy soil. Early in 1917, it was discovered that, if the tracks were connected together by a beam consisting of a light tree trunk, forward movement became possible under almost all conditions. This beam, having passed under the belly of the tank, had to be detached from the tracks and man-handled from the rear to the front as many times as might be necessary for the tank to reach firm ground, and during the whole time thus occupied the crew were exposed. In action, something better was called for, and eventually the continuous unditching beam was evolved. This beam was carried on the tank at all times; its ends could be chained to the tracks through side openings in the driver's turret without any member of the crew getting out of the machine. As the name implies, the unditching beam finally standardised on Mark IV and Mark V tanks could, if necessary, operate continuously. This was arranged by fitting a pair of angle rails to the top of the machine over which the beam could slide from rear to front, being drawn forward by the chains attaching the beam to the tracks. The rails were, of course, raised high enough above the roof of the tank to allow the unditching beam to clear all obstructions such as turret, exhaust pipes, etc.

There is no necessity, in the case of the lifeboat tractor, to provide for continuous action of the unditching beam as the boat crew can easily handle the beam from rear to front if one application of it is insufficient to bring the machine on to firm ground. Lugs are provided on the beam which engage with the tracks by a small sideways movement, so that attach-

ment or detachment is a matter of seconds. When the sprag beam is used for unditching purposes it is important that there should be no relative movement between the two tracks and thus arises one reason for the necessity of the differential locking device with which the machines are fitted. When a differential lock is fitted it is important to provide a safeguard to prevent any attempt to steer the tractor when the lock is operative. This is effected by means of an interlocking device which ensures that the steering wheel cannot be moved when the differential gear is locked and that the differential lock cannot be engaged until the steering wheel is in the neutral position.

When every precaution has been taken to ensure that the internal mechanism of a lifeboat tractor is effectively watertight, the most rigid tests are applied to ensure that nothing has been overlooked or is inadequate. The first of these tests consists in closing the exhaust and air-intake pipes and subjecting the interior to air pressure. In this condition, the tractor is submerged in water until it is completely covered, when the minutest leak of air is discernible. The first test of this nature is carried out before any oil is put into either the crankcase or gearbox, as it has been found that oil tends to close a slight leak. After immersion for several hours under these conditions, the internal pressure is released, oil is provided for the engine and gearbox, and the tractor is then run under water, being repeatedly stopped and started while submerged. This work is done, of course, before the frame, tracks, and track mechanism are added, but when the machine is otherwise complete with all working parts.

It might appear simpler to house the tractor power and transmission unit in a complete and separate waterproof casing, instead of individually waterproofing every possible inlet and joint. This alternative was carefully examined when the lifeboat roadless tractor was designed, some four years ago. The conclusion was reached that to make the machine waterproof by this method was quite impracticable without approximately doubling its weight.

After concluding the submergence tests, each completed tractor is subjected to an 8-hour non-stop run at full engine speed before being dispatched to the coast for the final acceptance tests. The latter include a trial launch and the hauling of the carriage and boat over the most difficult portions of the beach ever likely to be used.

Experience has shown that slight accumulations of water can be found in the enclosed parts of the tractor, which are not traceable to leakage. They are accounted for by condensation. After a launch, when the engine is shut down, the interior is filled with moisture and salt-laden air, and, as the tractor cools and the heated oil drains from the metal surfaces, this moisture condenses on them and in a very few days can lead to serious corrosion. To guard against trouble from this source, the standard procedure at all Royal National Lifeboat Institution stations, where these tractors are in use, is roughly as follows: Every time the tractor is used and before it is put away in the boat-house, it is thoroughly hosed down with fresh water. The engine is run daily for a period of about 15 minutes, until thoroughly hot, the tractor at the same time being both moved and steered. Samples of crankcase and gearbox oil are drawn off at frequent intervals from the lowest point to ensure that no leak has developed. Inspection of chambers not directly connected either to the sump or the gearbox is made at frequent intervals through the inspection covers provided.

While many unexpected difficulties were met with and overcome in the design and experimental stages of this tractor, there was one item from which trouble was expected and which in practice gave none. It was feared that, when running into the water, the radiator fan blades might easily be broken or distorted and that it would be necessary, though extremely difficult, to find means of enclosing the fan. In practice it was found that, immediately on entering the water, before the fan blades actually came into contact with it, the water picked up by the fan belt acted as a lubricant and had the effect of stopping the fan from working as long as it remained under water. As the engine cannot overheat during this time and as the services of the fan are not required, no adverse results arise, and a few moments after emerging from the water the moisture drains away from the fan belt and the fan starts working again.

The tractor described was by no means successful in its initial stages. As in so many matters, success was the outcome of a series of failures. Even to-day the details of construction are continually under review with the object of introducing improvements wherever scope for them can be shown. Nothing is regarded as final. Lifeboats even heavier than those now used are under consideration for beach launching. While the special machinery by which lifeboats are launched from an open beach has no general commercial significance, there are lessons to be learnt from it which can be applied in other directions.

"ENGINEERING" ILLUSTRATED PATENT RECORD.

ABSTRACTS OF SPECIFICATIONS RECENTLY PUBLISHED UNDER THE ACTS OF 1907 TO 1939.

The number of views given in the Specification Drawings is stated in each case; where none is mentioned, the Specification is not illustrated.

Where inventions are communicated from abroad, the Names, etc., of the Communicators are given in italics.

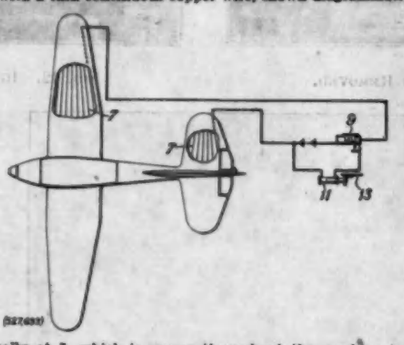
Copies of Specifications may be obtained at the Patent Office Sales Branch, 25, Southampton Buildings, Chancery-lane, London, W.C.2, price 1s. each.

The date of the advertisement of the acceptance of a Complete Specification is, in each case, given after the abstract, unless the Patent has been sealed, when the word "Sealed" is appended.

Any person may, at any time within two months from the date of the advertisement of the acceptance of a Complete Specification, give notice at the Patent Office of opposition to the grant of a Patent on any of the grounds mentioned in the Acts.

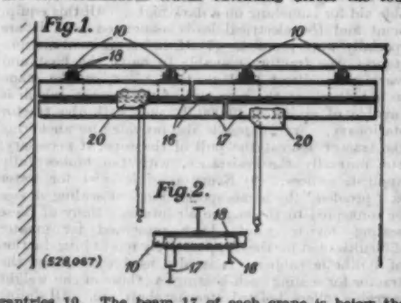
AERONAUTICS.

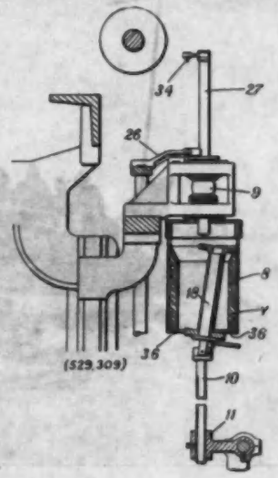
527,033. Target Aeroplane. F. Hills and Sons, Limited, of Manchester, and W. R. Chown, of Hale. (6 *Figs.*) August 17, 1938.—The invention is a control circuit for a "Queen Bee" type machine, which is fitted with a parachute to obviate crashing on landing. The whole of the components of the plane are fitted with a thin continuous copper wire, shown diagrammatically at 7, which is woven throughout the machine to form a closed circuit. The wire is in circuit with a battery and a normally closed relay 9, the relay controlling a secondary circuit which includes a solenoid 11 for operating a bolt which locks a trap-door 13 in the underside of the fuselage. The trap-door closes a compartment holding a parachute. Thus, upon breakage of the circuit by shell fire, the relay closes the solenoid circuit and the solenoid releases the bolt which allows the parachute to open and bring the plane safely to the ground. (*Accepted October* 15, 1940.)



LIFTING AND HAULING APPLIANCES.

528,067. Overhead Cranes. Geo. W. King, Limited, of Hitchin, and D. M. King, of Hitchin. (4 *Figs.*) April 26, 1939.—The invention is an arrangement of overhead travelling cranes whereby loads which are actually in the path of one crane can be lifted and transported by an adjacent crane. Two cranes run on parallel gantries lengthwise of the building and each consists of a pair of beams 16 and 17, which are spaced apart and are supported by rollers 18 running on the lower webs of the two parallel gantries 10. The rollers are mounted between a pair of angles which are secured to both the beams 16 and 17. The beam 16 of one crane is shorter than the corresponding beam of the other crane, while the beam 17 is longer, the arrangement being such, however, that when the cranes are in alignment there are two continuous tracks extending across the four gantries 10. The beam 17 of each crane is below the beam 16 so that the cranes can pass one another. The carriages 20, which run on the beams 16 and 17 have their haulage drum or other lifting gear suspended below and clear of the respective beam so that they can move backwards and forwards without hindrance. Automatic stops at the inner ends of the beams limit the travel of the carriages when the cranes are out of alignment. When the cranes are in alignment, each carriage can be transferred from one crane to the other, so that each crane has a range extending over the three bays defined by the gantries. Further, the carriage supported on the longer beam can, when the cranes are out of alignment, raise and convey loads situated in the path of the other crane owing to the fact that the beam projects into the bay along which the other crane travels. (*Accepted October* 22, 1940.)



TEXTILE MACHINERY.

529,300. Centrifugal Spinning Machine. Prince-Smith, Limited, of Keighley, and W. Prince-Smith, of Keighley. (6 *Figs.*) May 15, 1939.—The invention enables yarn which has been laid in the yarn holder to be recovered after the breakage of a yarn, and spinning to be recommenced in that holder with minimum loss of time. Overhead cages, each carrying upper and lower ball bearings, are secured at intervals along a rail, the bearings carrying the tubular stem of an inverted cup-shaped yarn holder 8, which is driven by a tape passing around a whorl 9 fixed to the stem. Below and co-axial with each yarn holder is a grooved spindle 10, adjustable in a bracket 11, in which it is locked by a set screw. At the upper end of each spindle 10 is carried the pivot for a bobbin peg 18, which is normally held vertical by a spring. The upper end of the bobbin has a flanged metal cap round the edge of which is a rubber ring. A bracket 26 is secured to the traverse rail adjacent to each spindle unit and supports a sliding tube 27, fitted at its lower end with an eyelet and constituting a traversing guide. From its upper end to below the middle of its length runs a vertical slot terminating in an off-set recess at its lower end; and the tube is detachably connected to the bracket 26 by a depending peg 34 engaging its forward end. During the operation of the machine, yarn is delivered to the tube 27 and emerges through the eyelet to be laid centrifugally upon the inner surface of the revolving yarn holder 8, in which an annulus Y of yarn is gradually built up. If, during this process, the yarn breaks, the annulus already spun is recoverable in the following way: the operator disconnects the traversing tube 27 from the traversing rail by lifting the tube and withdrawing the peg 34 from the bracket 26, the tube being locked by turning it until a fixed bracket enters the offset recess. The spindle 10 is then raised until the bobbin is at the correct height within the yarn holder 8. The operator then tilts the bobbin into the position shown so as to bring the rubber ring for a short period into contact with the surface of the rotating annulus of yarn. A few coils of yarn are retarded and the winding of the yarn on to the bobbin is thus begun. The bobbin is then released and assumes a vertical position in which the transference to it of the remainder of the yarn in the holder is completed. The spindle 10 is then dropped and the bobbin is removed from the peg 18 to be replaced by an empty bobbin. To restart spinning in the yarn holder, the operator first lowers the tube 27 until the eyelet is below the level of the bottom edge of the holder. A short length of yarn is passed by hand through the tube 27 and is caught up by diametrically opposed pegs 36 at the lower end of the yarn holder. The tube 27 is then raised into the spinning position, the peg 34 being engaged with the bracket 26. The short length of yarn is now centrifugally controlled by the yarn holder 8 and is joined up to the yarn being delivered. Spinning can then proceed, the other yarn holders in the machine not having been interrupted during the whole process. (*Accepted November* 19, 1940.)